

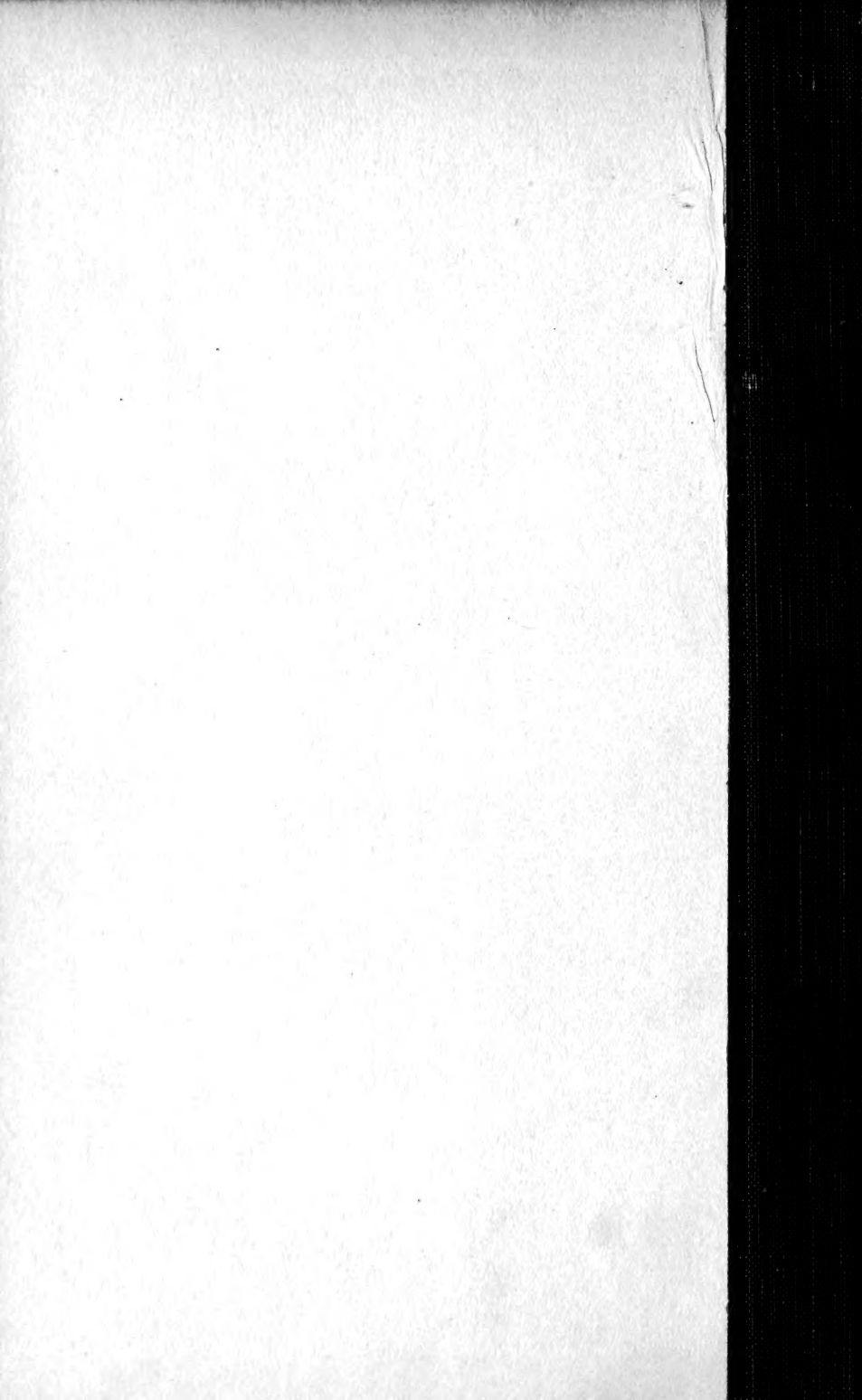
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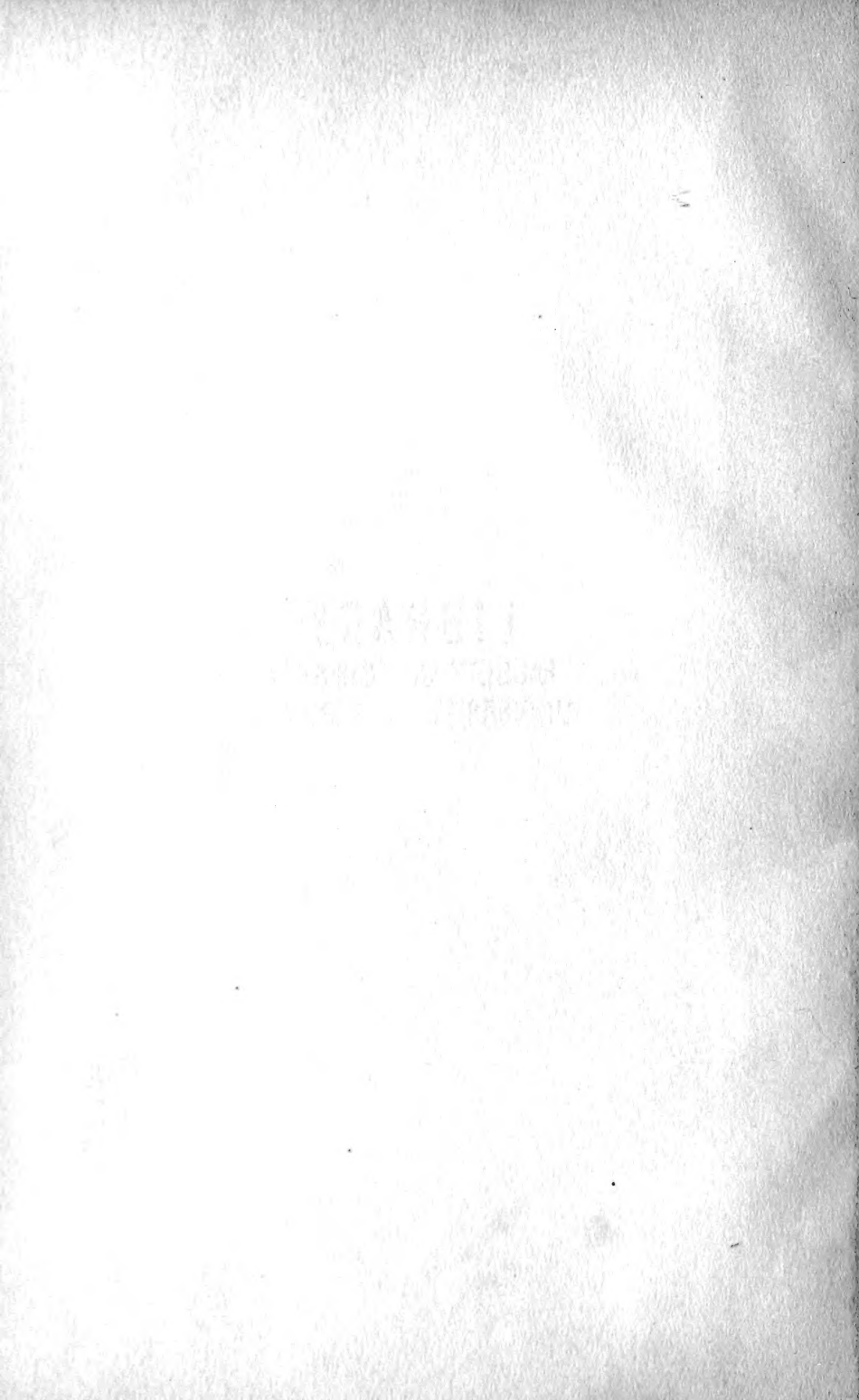
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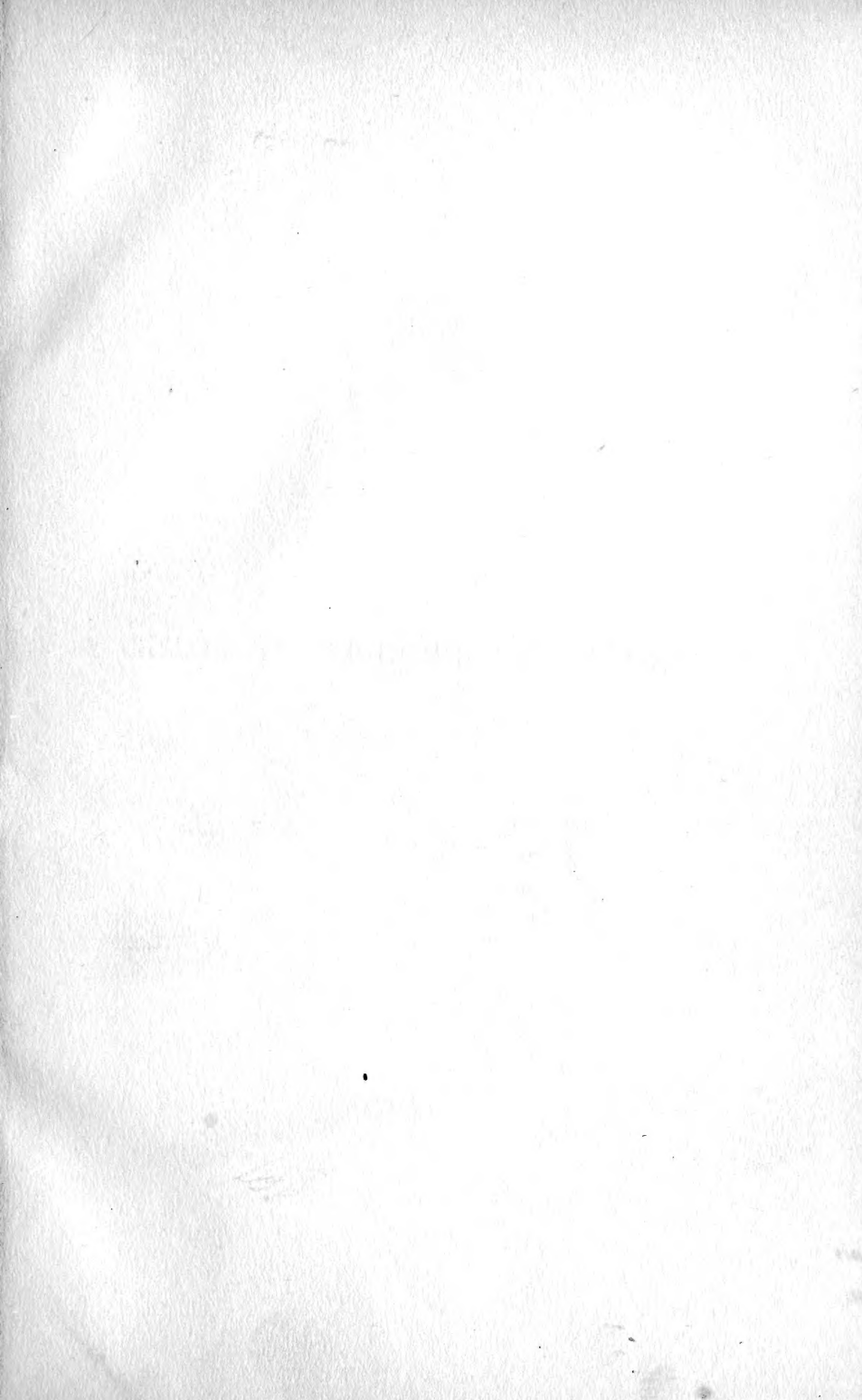


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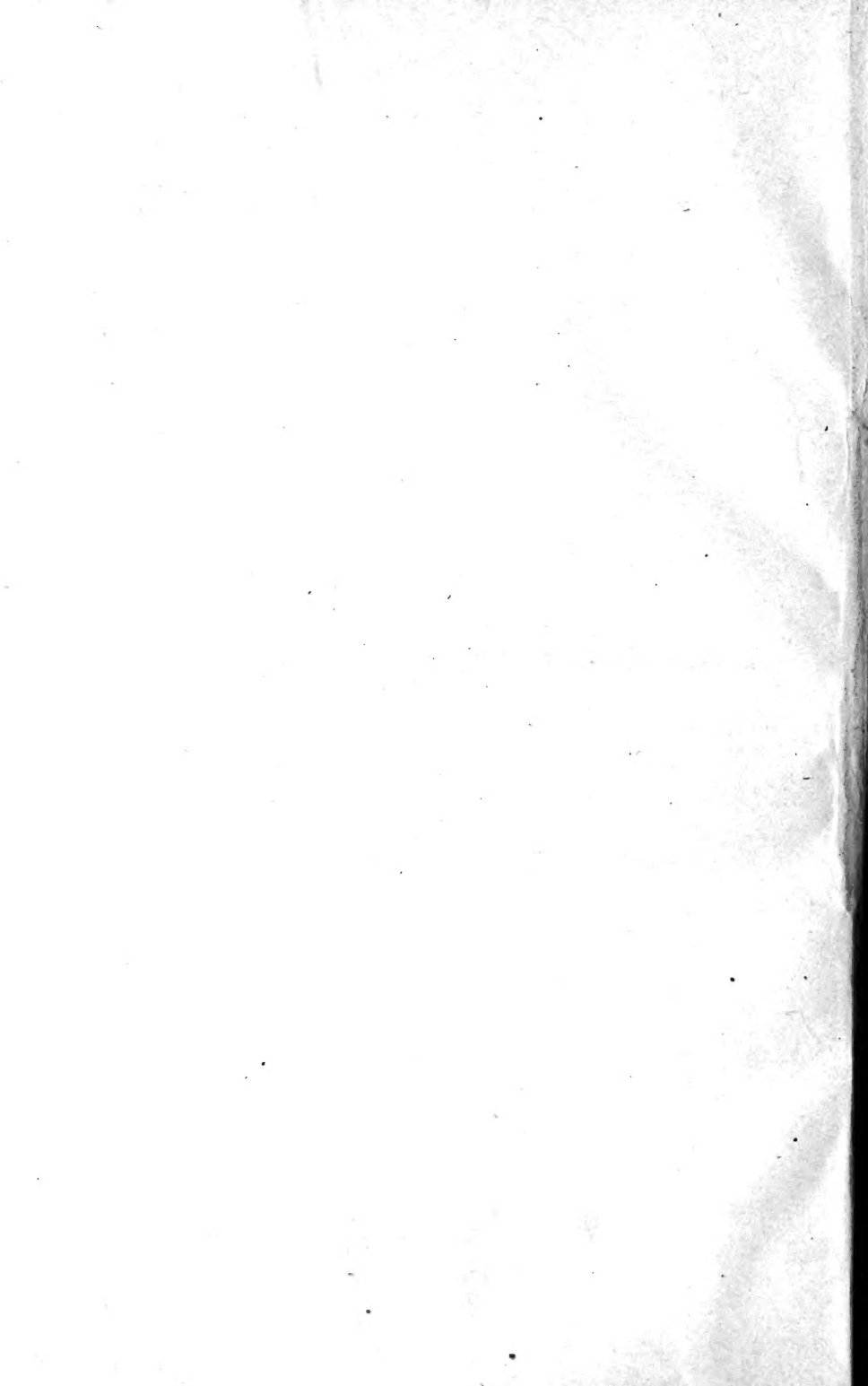






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**A GUIDE TO TIMBERS OF NIGERIA**



# A GUIDE TO THE IDENTIFICATION OF THE MORE USEFUL TIMBERS of NIGERIA

BY  
HERBERT STONE

AND

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DIPLOMA IN FORESTRY

Lecturers in Forestry at the School of Forestry, Cambridge

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## PREFACE

THIS brochure is the first of a series which will, it is hoped, extend to the whole of the more useful woods of Africa. At present, however, we confine ourselves to those species only which have been sent to us by the Government of Nigeria for the purpose. Many of the woods are very widely distributed, in some cases ranging from Senegal to the Sudan and from the Cape to the East African Protectorate, hence our descriptions may be found useful by those interested in the timbers of the adjacent regions.

Our method of identification is based upon the examination of the solid wood by means readily applicable to all, after preparation (smoothing) with glass-paper, pumice-stone, the sharp edge of broken glass, by the plane, or even by the use of a hone. Each wood may demand a different method to bring it into a condition in which the structure will be clearly visible. Hence in comparing our descriptions it will be necessary to treat the wood in the same way as stated in the schedules in connection with each species under the paragraph "transverse section." The various tissues are thrown into relief by different processes, for example, the wood-parenchyma, or soft-tissue, is made visible by the use of glass-paper, whereas it is frequently obscured by the use of a plane. A corner of the wood cleanly cut with a razor will serve as a control.

The means of magnification are: a hand-lens affording about three diameters, and a hand-microscope (which we shall refer to as a "macroscope") giving about ten diameters. Our figures are all enlarged by three diameters, to accord with the image obtained by the hand-lens. The hand-microscope can easily be made by detaching the tube of a student's microscope together with its eye-piece and objective, and fitting it with an external sliding tube (of sheet metal, cardboard, or even



wrapped paper) that will serve as a means of regulating the focal distance. A gap must be cut in the side of the tube to admit the light to the object to be viewed. Other accessories are: a small plane (iron stock preferred), a razor or sharp knife, a supply of glass-paper (No. 00), a piece of pumice-stone with one surface ground flat, and a fine hone, which will serve for whetting the cutting-tools and for smoothing the cross-section of certain obdurate woods. The whole of the apparatus will add but little to the impedimenta of a prospector.

As the vernacular names used in the various colonies are of great use in identification, we have compiled a list from all sources. These names are not, however, confined to those met with in Nigeria, but are all that we have found connected with the various species in any colony, and also in French, Italian, and German works. Much duplication arises from the different methods of spelling adopted by authors, and many of the names are obvious errors in transcription. Further, many native names are of a general character and apply to several species of the same genus or family (hereafter indicated by the abbreviation "com."), or even to trees superficially resembling each other, or used for the same purposes. In such cases we specify the trees concerned, but in any event, *so long as the native names are checked by the descriptions of the woods*, the reader will not be misled. We have not thought it necessary to append the name of the tribe using any particular tree-name, as the former is of no interest in this connection, and the addition would entail much repetition, space and type-setting.

The Key to the species can only be followed by readers having already some acquaintance with the macroscopic structure of woods, but notes and diagrams are provided so that with a little practice all the features necessary for the use of the Key can be understood. We are indebted to Mr. R. A. Sykes, B.A., Probationer to the Colonial F.S., for his assistance in checking the Key and for his suggestions for its improvement. Mr. Sykes' knowledge of the Nigerian woods has been of great service.

All the descriptive schedules are constructed on the same plan, and each detail falls approximately in the same place, and can thus be readily found for comparison. Identical terms are used to describe similar structures, and any variation

in the phraseology indicates a difference in the structure of the wood concerned.

For the formal matter, vernacular names, localities, etc., we are indebted to the authors enumerated in the Bibliography, to whom we express our thanks. Special mention should be made of Mr. Harold Unwin's compendious work on *Forests and Forestry in Nigeria*, and to Mr. J. H. Holland's *The Useful Plants of Nigeria*, for not only have we availed ourselves of the great amount of information therein accumulated by these authors themselves, but in some cases we have been led to seek the works of other authors by means of their references and bibliographies, for which they should have credit.

The whole of the specimens described herein, as well as many others from various sources, are deposited in the collection of the School of Forestry, Cambridge, where they may be consulted. To facilitate this we have quoted the serial number of each specimen.

Unfortunately, it is but rarely that a specimen has been accompanied by the name of the collector. As this detail is of the first importance we strongly impress upon all friends who send us specimens the imperative necessity of proper authenticity. Failing this, our custom is to accept a specimen as being of a reputed species whenever we find that it agrees with others similarly reputed, that have been received from different sources, otherwise the identity of the specimen must be regarded as provisional only.

The generic numbers given are those of Bentham and Hooker (see also Th. Durand's *Index Plantarum Phanerogamorum*), the sequence corresponding to the systematic arrangement of those authors. Though the classification of Engler is more in vogue, we adhere to that of Bentham and Hooker, inasmuch as most of the literature with which we have to do is based on the latter system, and also because the extensive collection of the School of Forestry is arranged according to the same plan.

The notes supplied to us by the Conservator of Forests have been appended to the various species concerned.

Much help has been received from the members of the Cambridge University Forestry Association, especially from Mr. A. J. Wilson, by whom most of the photographs for our plates have been taken.

We are indebted to the Government of Nigeria, not only for the valuable series of specimens sent to the School of Forestry, but also for assistance in the publication of this brochure, the whole of the cost having been borne by that Government. For this we tender best thanks.

HERBERT STONE.

H. A. COX.

SCHOOL OF FORESTRY,  
THE UNIVERSITY,  
CAMBRIDGE,  
*January 1, 1922.*

# CONTENTS

	PAGE
PREFACE . . . . .	5
BIXACEÆ . . . . . <i>Scottellia kamerunensis</i> .	11
GUTTIFERÆ . . . . . <i>Garcinia</i> sp. . . . .	12
OCHNACEÆ (DIPTEROCARPACEÆ). <i>Lophira procera and alata</i>	14
BOMBACEÆ . . . . . <i>Eriodendron guineense</i> .	17
STERCULIACEÆ (TRIPLOCHITONACEÆ) <i>Triplochiton scleroxylon</i>	19
HUMIRIACEÆ . . . . . <i>Saccoglottis gabonensis</i> .	21
SIMARUBACEÆ . . . . . <i>Klainedoxa gabonensis</i> .	23
MELIACEÆ . . . . . <i>Guarea</i> sp. . . . .	24
	<i>Khaya grandis</i> . . . . .
	26
	<i>Lovoa Klaineana</i> . . . . .
	28
LEGUMINOSÆ—	
PAPILIONACEÆ . . . . . <i>Pterocarpus tinctorius</i> .	31
CÆSALPINEÆ . . . . . <i>Paradaniellia Olivierii</i> .	35
	<i>Afzelia africana</i> . . . . .
	37
	<i>Brachystegia spicæformis</i> .
	41
	<i>Erythrophleum guineense</i> 43, 46
MIMOSEÆ . . . . . <i>Cylicodiscus gabunense</i> .	47
	<i>Piptadenia africana</i> . . . . .
	49
	<i>Albizzia</i> sp. . . . .
	52
COMBRETACEÆ . . . . . <i>Terminalia superba</i> . . . . .	53
	<i>Terminalia</i> sp. . . . .
	55
FLACOURTIACEÆ . . . . . <i>Casearia</i> sp. . . . .	56

	PAGE
RUBIACEÆ . . . . .	<i>Sarcocephalus esculentus</i> . . . . . 57
	<i>Sarcocephalus sambu-</i>
	<i>cinus</i> ? . . . . . 60
	<i>Adina microcephala</i> . . . . . 62
	<i>Mitragyne macrophylla</i> . . . . . 64
APOCYNACEÆ . . . . .	<i>Alstonia congensis</i> . . . . . 66
EUPHORBIACEÆ . . . . .	<i>Uapaca Staudtii</i> . . . . . 69
	<i>Ricinodendron africanus</i> . . . . . 70
	<i>Excoecaria</i> sp. . . . . 72
MORACEÆ . . . . .	<i>Chlorophora excelsa</i> . . . . . 73
Unidentified . . . . .	<i>Akoto</i> . . . . . 76
	<i>Apara</i> . . . . . 78
	"Oregbo Erin" . . . . . 79
	<i>Papapa</i> or <i>Papara</i> . . . . . 81
KEY TO THE SPECIES . . . . .	83
DESCRIPTION OF THE PLATES . . . . .	95
BIBLIOGRAPHY . . . . .	98
INDEX . . . . .	103

## DESCRIPTION OF SPECIES

**Scottellia kamerunensis**, Gilg. Bixaceæ. Gen. No. 523.

As *Dasylepis* in Hooker's *Icones Plant.* XIII. t. 2265.

LOCALITIES.—Ivory Coast, Nigeria, Gaboon.

VERNACULAR NAMES.—Akosica ; Akossica (not Assoseka, as Chevalier (1909, pp. 148 and 269) mentions both separately). Edde ; *Eddé* ; Okilolo ; Bélarbinekélé.

Description of the wood from a specimen No. 3008 "Ako-sica" (Empire Timber Exhib. 1920) received from the Government of Nigeria.

GENERAL CHARACTERS.—A moderately hard and heavy wood of a nearly uniform white colour with a suggestion of yellow here and there. The colour hardly deepens, but the wood loses its brilliance when weathered. Surface clean, not cold to the touch, dry, soils easily. Shade of the transverse section a little browner and darker than that of the other sections. Grain fine, open, straight. Smell, none.

STRUCTURE.—Very characteristic.

*Transverse section.* (Prepared with glass-paper.)—See Pl. IV, fig. 4. Parenchyma of one kind : (a) vasicentric, just visible with the unaided eye as fine specks around the orifices of the pores ; scanty.

Vessels just visible with lens as perforations, very small, uniform in size and fairly so in distribution, but with a tendency to collect in zones ; rather crowded ; 50–60 per sq. mm. ; arrangement indefinite ; shape, shortly oval ; contents, light golden resin in small quantity and also a little of a darker colour. Proportion of the wood about one-third.

Rays very easily visible, being very large, numerous and white ; of two kinds ; the larger milk-white, irregular in size, fairly regular in spacing, gently curved, otherwise straight ; many thin ends and all tapering strongly inwards ; not nodose

at the ring-boundaries; 9–10 per mm.; proportion of the wood about one-third.

Ground-tissue-cells visible with macroscope; proportion of the wood about one-third.

Rings not traceable at all.

*Radial section*.—Colour much whiter than the other sections on account of the large white flakes of silver-grain against the decidedly yellow ground, both are lustrous and change with the incidence of the light. Grain, fine, open, straight, nearly empty. P. (a) just visible with the lens as tails to the vessels.

*Tangential section*—as the radial, but the larger rays appear as lines rarely exceeding  $\frac{1}{4}$  inch in height; the smaller rays are not visible with lens, lacking contrast. The large rays are apparently in échelon and thus form bands which are distinctly visible over long lengths (over 10 inches). Small rays not in parallel. The shining linings of the vessels show up as glistening points.

DENSITY.—No. 3008, 0.72 or about 45 lb. per cubic foot.

Chevalier (1909, p. 148) gives 0.658 and (1917, p. 60) 0.753.

BARK.—“Whitish, not fissured, but covered with wide depressions” (Chev. l.c. and 1917, p. 60) “Rusty-white, wrinkled, not fissured, with elliptical depressions of the size of a five-franc piece; thickness unequal, thin and adherent to the sapwood.”

### ***Garcinia* sp., Guttiferæ. Gen. No. 654.**

Specimen “Agberigbede,” No. 3609 received from the Government of Nigeria (Lagos). Alternative name, “Agberignedé.”

GENERAL CHARACTERS.—A wood of medium weight and hardness, coarse-grained and of a yellowish or brownish-red colour much resembling a Cedar (*Cedrela*); dry to the touch, not cold; transverse only slightly darker than the other sections; smell, none when dry; works easily to a lustrous surface.

STRUCTURE.—*Transverse section*. (Prepared with the plane.) See Pl. II, fig. 5. Parenchyma of one kind only: (a) sheathing the vessels, extending tangentially and uniting them into undulating lines which are often continuous over considerable distances, frequently anastomosing; colour buff; width of



lines about equal to the smaller spaces between the rays and at intervals of about  $1\frac{1}{2}$  times to twice their own width ; equally abundant within any apparent ring, but occasionally interrupted by a denser zone which may be the limit of the ring ; proportion of the mass of the wood (including the vessels) about one-quarter.

Vessels readily visible to the<sup>e</sup> unaided eye as perforations apart from their parenchyma, very large, apparently not diminishing in size ; variation in numbers little, except in the dense zones ; number per sq. mm. 5-8 ; a tendency to an arrangement in échelon, otherwise they are widely isolated ; oval ; mostly empty.

Rays on the limit of vision, very fine ; colour as the parenchyma, but slightly darker ; of one kind only, multiseriate, straight : number per mm. 5-8 at intervals of about their own width to that of a pore, and irregularly spaced ; fairly regular in size ; proportion of the mass of the wood between one-quarter and one-fifth.

Ground-tissue-cells readily visible with the macroscope ; proportion of the mass rather more than one-third.

Rings apparently defined by the denser zones ; contour regular.

*Radial section.*—Vessels very coarse, open and empty, having loculi *readily visible to the naked eye*, size of vessels equal to those of the Common Oak ; linings bright : the macroscope shows very regular pitting in the vessels where they are in contact with the rays. Parenchyma (a) appears as hoary lines and as borders to the vessels. Rays inconspicuous, but visible as minute hoary flakes, more so by reflection. Grain rather oblique.

*Tangential section* as the radial, but the rays are visible with difficulty by reflection owing to their lack of lustre. They are minute spindle-shaped lines up to about  $\frac{1}{16}$  inch high and whitish in colour. Parenchyma very distinct in certain lights in hoary lines and zigzag tracery.

Pith ?

SAPWOOD well but not sharply defined from the heartwood, colour pale buff or dirty white (about 1 to  $1\frac{3}{4}$  inches wide in specimen). Exterior of the log striated, due to the vessels which are salient.

Bark ?

DENSITY.—0.635 or about 39½ lb. per cubic foot.

USES.—This wood is of good appearance and should pass as a Mahogany-substitute.

Illustrations.—Those given by Baragli-Petrucchi for *Garcinia nigricans* in *Malpighia*, Vol. XVII (1903), Pl. XII, tr. and tg. sections, are near.

**Lophira procera**, A. Chev., and **L. alata**, Banks. Ochnaceæ (Dipterocarpaceæ). Gen. No. 711.

LOCALITIES.—Senegambia, Upper Guinea, Sierra Leone, Gold Coast, Ivory Coast, Togo, Nigéria, Brit. sphere Cameroons, French Central Africa, Nile-land.

Thonner, p. 359, under "*Lophira*," says "species one," and as we can discern no difference in the woods sent to us under either name, we treat them as synonyms. The native names are no doubt interchangeable. *L. alata* appears to be a small scrubby tree, and *L. procera* furnishes the large timber. Chevalier (1913, p. 70) separates the two species, stating that *L. alata* grows in the savannahs of the Sudan and (1909, p. 154) *L. procera* affects the coastal region of the Ivory Coast.

VERNACULAR NAMES.—Akogha; Akoura; Akpapia; Awigbo; Azobe; Bambarra; Bang; Bangossi; Belengbé; Bilingbe; Blackheart; Boko; Bokoa; Bongossi; Dervo; Eba; Ebba; Eisenholz; Eki; Ekki (not Eku); Ela; Eleba; Endwi; Entwi; Enwan; Eso; Esoré; Gara; Hendui; Ipahan; Ipahau; Ipawhaw; Ironpost; Ironpost, red; Ironwood; Ironwood, dry zone red; Ironwood, dwarf; Ironwood, small red; Ironwood, red; Ishan; Kako; Kakoo; Kaku; Katank; Kekrefunde; Kokank; Kotoblassu; Kotublassu; Kuru; Laintlain; Mana; Mana-manar; Meenzerrah; Méné; Mench; Méné-oil-tree; Meno; Millai; Milley; M'toto; Namijinkadai; Namijin kade; Ndonga; Niam; Niam fat-tree; Nijinkade; Nokoue; Nokué; Nungka; Oak, African; Oak, African, red; Oak, scrubby; Okikopon; Okoka; Okot; Okut; Otugba; Oue-oue; Parapara; Ponhon; Ringa; Sanga; Ughberi; Umowanek; Umpenek; Bois de fer; Wowata; Yagale; Zawa.

Description of the wood from a specimen No. 3012 received from the Government of Nigeria (Empire Timber Exhib. 1920).

Our specimens No. 3094 "Hendui" from the Gold Coast (McDonald) and 1994 HS. "Blackheart" from a commercial source, 2808 H.S. "Kakoo" from the G.C. and 0872 HS. "Eki" from the Yoruba district W. Coast Africa, and another "Wowata" No. 2746 from the San Pedro River, all agree. The last number was authenticated by Sir W. Th. Dyer. No. 2856 HS. "Upenikwa" from S. Nigeria does not agree.

GENERAL CHARACTERS.—A very hard and heavy wood of a deep red colour resembling that of dried blood, striated with paler lines, and also white lines due to the great quantity of a white deposit. Surface clean, cold to the touch, a little clinging on the more porous parts only, but hardly likely to soil much. Colour fades on exposure. Grain, coarse, open, very much inclined, the angle changing from ring to ring. Shade of the transverse section slightly darker than that of the other sections. Smell, faint but unpleasant when revived by moistening.

STRUCTURE.—Recalls that of *Pterocarpus*.

*Transverse section.* (Prepared with glass-paper.)—See Pl. II, fig. 1. Parenchyma of two kinds: (a) vasicentric, and (b) concentric.

Parenchyma (b), visible in very numerous, undulating, continuous concentric lines, which are about as wide as six times the breadth of a ray; at intervals in a radial direction, of about the longer diameter of a large pore; colour intermediate between that of the rays and of the P. (a); occasionally branching; contains crystals. Vessels very clearly visible and even prominent (as perforations); very large, little variation either in size or numbers, but perhaps a slight increase in size as the tree ages; widely isolated, but fairly evenly distributed, with a distinct tendency to a radial arrangement en échelon; 0-4 per sq. mm. mostly in m-and-d groups of 2-3 pores; shape, oval; contents white, abundant and a feature, also a little red resin. Proportion of the wood, small. Rays just visible with the lens (more visible when dry), very fine; of one kind only; lighter in colour than the ground tissue; intervals regular, usually two but sometimes three to the pore, diam. 15-18 per mm.; contents, some crystals; proportion of the wood about  $\frac{1}{4}$ . "Slightly nodose where they cross the lines of P. (a)" (Hopkinson, p. 454). Ground-tissue extremely

dense, cells not visible with the macroscope. Rings not traceable for the most part, but there are lighter and darker zones; contour regular.

*Radial section.*—Colour uniform except as to the white striæ due to the grain being filled with a white deposit; also a little red resin; there are few empty vessels. Rays, very fine lines rather than flakes, having the appearance of being interrupted by the P. (b). P. (a) prominent as light coloured borders to the vessels. P. (b) just visible as vertical lines.

Density, No. 2808 HS., 1.034, or about  $64\frac{1}{2}$  lb. per cu. ft.

„	„	3085,	1.042,	„	65	„	„
„	„	3012,	0.92,	„	$57\frac{1}{2}$	„	„
„	„	3094,	1.15,	„	72	„	„
„	„	1994 HS.	1.04.	„	65	„	„

Holland gives 1.0208, and Chevalier (for *L. procera*) 1.110 and 1.078. Illustrations of structure. Stone, 1904, Pl. I, fig. 6, tr. sec. x. 3. Hopkinson, 1912, p. 453, fig. 21, tr. sec. x. about 50.

*SAPWOOD.*—Unwin, 1920, pp. 357–9, says of *L. alata* “narrow and white”; of *L. procera*, “whitish-red 3 to 4 inches thick in a tree of 12 feet girth.” From specimen No. 3094, sapwood greyer and lighter in colour and well defined from the heartwood, width 4–5 inches; the linings of the vessels appear to become coloured first. Exterior of the log striated, but nearly smooth.

*BARK.*—Unwin (l.c. p. 107) says of both species “bark dark and rough” and p. 358 “orange coloured and almost scaly in the younger trees; changes to grey or black when exposed to light or grass-fires.” Chevalier (1909, p. 154) says “bark (of *L. procera*) smooth, scaling in small superficial plates,” and again (1917, p. 105) “of a light chestnut colour scaling in large rather thick plates; section reddish-yellow; about 8–12 mm. thick.”

*USES, ETC.*—Unwin (l.c. p. 107) of *alata* “poles, sleepers; house-posts; is termite-proof.” Of *procera*, p. 357, “resists white ants and teredo,” and p. 359, “piles, wharves, bridges, pestles, mortars, canoes; its hardness much limits its use.” At the Empire Timber Exhibition of 1920 we were informed that this latter species was being exported to India (!) for sleepers. In point of durability and strength, especially as

regards resistance to compression vertically to the grain, this wood should admirably answer the purpose, but it will need four men to handle a sleeper instead of two.

*Conservator's note.*—"A tall, fairly straight-growing tree. New leaves, which at first are bright red, appear in October and November. Plentiful in the evergreen forests, growing in both swampy and well-drained situations.

"The dark brown timber, which will not float, is very durable. It is suitable for piles, lasting well in brackish water. It is largely used by the Public Works Department in house-building where strength is required, and also in exposed positions. The natives make use of it for canoes. It is not eaten by termites."

**Eriodendron guineense**, Schum., et Thonn. Bombacææ.  
Gen. No. 772.

Synonyms: *E. anfractuosum*, D.C.; *Ceiba pentandra*, Gaertner; *C. casearia*, Medic; *Bombax pentandrum*, L. We follow Chevalier (1909, Vol. V, p. 187). The only African species according to Thonner (p. 352), but Unwin mentions *Ceiba* and *Eriodendron* together on p. 435 (1920). Holland, 1908, p. 87, cites *E. anfractuosum*, Steud., Dalziel gives *E. orientale*, Steud., and Salesses *Bombax guineense* (author not stated).

LOCALITIES.—Upper and Lower Guinea, Senegambia, Sierra Leone, Liberia, Gold Coast, Ivory Coast, Congo, Nigeria, Gaboon, Tanganyika Territory, Lake Tchad.

VERNACULAR NAMES.—Those given for the French colonies are in connection with the synonyms *B. guineense* and *E. guineense*, authors not stated. Aguegbé; Akbo; Akpe; Araba; Baumwollbaum; Benten; Bentenier; Bintafora; Cottonnier, faux (com.); Cotton-tree, Silk Cotton-tree (com.); Cotton-tree, Silk Cotton-tree, white; Dragounier; Egna; Eggun; Emanga; Enyena; Enyenga; Enyina; Enyo; Fromager; Goué; Gung; Kapok (com.); Kapokier (com.); Mafuma; Mafumeira; Meesoofee; M'kung; Monong; Mufuma; Mufumiera; Nguéhié; Oca; Odoum (not Odum); Ofwho; Okha; Ongina; Onyina; Ouia; Pullum; Rini; Rimi (com. to *C. orientale*); Shakka; Simoma; Somba-umba; Suma-uma; Tonko; Ukun; Ungwe.

Description of the wood from a specimen, No. 3109 "Araba"

(Empire Timber Ex. 1920), received from the Government of Nigeria.

**GENERAL CHARACTERS.**—A very light soft wood of an oatmeal colour very much resembling that of *Ricinodendron africanus* (see that species). Surface dull, warm to the touch; would soil readily. Very cross- and coarse-grained, open. Shade of the transverse section lighter than that of the other sections. Smell, none. Very absorbent.

**STRUCTURE.**—(More visible in the tainted portions.)

*Transverse section.* (Prepared with the plane.)—Parenchyma of one kind only: (a) in small quantity, narrowly sheathing the pores; visible to the unaided eye in vertical section only. Slightly darker than the ground-tissue.

Vessels visible as perforations, very large; not diminishing in size outwards towards the ring boundary, but distinctly fewer in numbers, with a tendency to collect in the inner zone of the ring; 2–5 per sq. mm.; a distinct oblique arrangement of the pores; mostly simple, but a few groups of two or three pores here and there; widely isolated; shape, shortly oval; tyloses abundant; proportion of the wood, small.

Rays easily visible though fine; of one kind only; straight, except where they avoid the pores; regular in spacing at intervals of about the smaller diameter of a large pore apart; colour white or straw-yellow; denser than the ground-tissue, 6–9 per mm.

Ground-tissue exceedingly lax, the cells can be counted with the aid of the microscope, and when moistened they swell more than those of the rays.

Rings traceable with difficulty; boundary a fine white line, often repeated, and contour regular.

*Radial section.*—Colour uniform except as to the vessels, which are dark, filled with tyloses and very coarse and straight. P. (a) visible as fine tails to the vessels. Rays easily visible, brownish, darker than the ground-tissue, containing much more red, lustrous resin. Rings hardly traceable.

*Tangential section* as the radial, but there are numerous fine parallel lines, possibly septa of the fibres, visible with the microscope, which need further investigation. Rays visible as a half-tone effect; height about 20 cells or up to 1.5 mm.; not in parallel; the cells contain resin globules.

*Density*.—No. 3109, 0.277 or about  $17\frac{1}{2}$  lb. per cubic foot. Engler gives 0.44 or about 27–28 lb. per cubic foot; Chevalier, 0.281.

*BARK*.—"Greenish, smooth, a marked character" (Sim., 1909, p. 17). "Wrinkled, scaling in small plates with large spines" (Chevalier, 1909, p. 188).

*USES, ETC.*—"Canoes, platters" (Unwin, p. 53). "The tree has buttresses rising from the roots to a height of 3–4 metres up the trunk; wood of no use for paper-pulp on account of its grey colour" (Chev., l.c.). W. J. Farrell, p. 22, suggests the use of this wood for the making of violins, and says that for strength, lightness and acoustic properties he has never come across anything like it. Our specimens are possibly in bad condition, as they are of very inferior wood.

***Triplochiton scleroxylon***, K. Schum. Sterculiaceæ (Triplochitonaceæ in Hooker's *Icon. Pl.* t. 2758). Gen. No. 791A.

Synonym: *T. Johnsonii*, Ch. Wright. We follow Chevalier (1909, p. 257).

*LOCALITIES*.—Gold Coast, Togo, Ivory Coast, Nigeria.

*VERNACULAR NAMES*.—Arere (com. also to *T. nigericum* and to a Palm *Elæis*; Hofa; Maple, African, bush; Obeche; Obechi; Owawa (not Owawe); Owa-wa; Patabua; Sama; Samba; Sankamba; Serama; Satinwood (Liverpool market, see Unwin, 1906, p. 352); Wa-wa (com.); Wawa; Waw-waw.

Description of the wood from a specimen, No. 3622 "Arere," received from the Government of Nigeria (Lagos). Our specimens Nos. 3017 and 2799 HS. agree.

*GENERAL CHARACTERS*.—An exceedingly light and soft wood of a very pale buff colour, with occasional slightly darker stripes, corresponding to the apparent boundary of the rings. Much resembling the wood of *Ricinodendron*. Surface dull; grain, coarse and open, but the number of the pores seen on the surface is small; direction of pores very oblique. Warm and dry to the touch. Shade of the transverse section darker when clean cut, but lighter when glass-papered. Smell, none. Soils readily.

*STRUCTURE*.—*Transverse section*. (Prepared with glass-paper, also clean cut with razor.)



Parenchyma (*a*) in very small quantity sheathing the vessels : white.

Vessels readily visible as perforations, very large but varying greatly in size and numbers, the larger being apparently on the inner edge of the ring. Number per sq. mm. 0-5. Arrangement indefinite, but in zones here and there. Simple for the most part, but there are (radial) groups of as many as 4. Shape, oval. Contents, shining yellow tyloses. Proportion of the mass of the area of the section (including parenchyma) scarcely more than one-twentieth.

Rays visible as fine white lines, somewhat irregular in size, and in spacing, rather less than a pore-width apart, but having numerous fine ends between the thicker middles ; very slightly avoiding the pores ; number per mm. 4-8. Proportion of the mass of the wood, nearly half.

*Ground-tissue-cells* very large and visible with a good hand-lens. Proportion of the mass of the wood, about  $\frac{1}{2}$ . Cells very variable in size.

*Rings* extremely indefinite ; apparently clear to the naked eye, but little if any indication of true boundaries when magnified.

*Radial section*.—Colour, buff, mottled with a small pretty silver-grain. Grain, very coarse, the pores occasionally filled with large shining yellow tyloses ; the loculi of the vessels are about as broad as long. Parenchyma just visible with lens as very narrow, hoary borders. Rays as above covering about half the surface ; height up to 2.5 mm. Rings not defined, but dusky bands sometimes prominent.

There is a tissue indicated by numerous fine white lines, which evidently represent uni-cellular strata in a horizontal plane, as they are traceable continuously from one section to another, having the same appearance on all vertical sections. They are not apparent on the transverse section. These will be the subject of further investigation.

*Tangential section* as the radial, but the rays are very obscure and dull, being just visible by reflected light as small white spindle-shaped lines producing a matt effect ; width up to four cells.

*Pith ? Sapwood ?*

*Density*, No. 3017, 0.405 or about 25.6 lb. per cu. ft.

*Density*, No. 3622 0·48 or about 30 lb. per cu. ft.

Unwin (p. 352) gives 35 lb. Chevalier (p. 255) gives 0·283, or when freshly-felled 0·40.

**BARK.**—Chevalier (1909, p. 255) says “whitish, falling away in irregular scales; red and mucilaginous within.”

**USES, ETC.**—“Pirogues, by the natives; should be interesting to the European furniture trade; much superior to Lime or Poplar, which it might replace” (Chev. l.c.). “A good timber-tree; wood strong, works well; a tall and straight-growing tree; wood rather liable to warp when seasoned; not termite-proof, and suffers severely from the attacks of a small weevil” (Unwin, 1920, p. 351). “The tree has powerful buttresses like *Eriodendron*, but is spineless” (Chev. l.c.). Our specimens are far from being equal in quality to Lime or Poplar; the wood should find local use for temporary purposes.

*Conservator's note.*—“A tall, straight-growing, deciduous tree with buttresses up to 4 or 5 feet from the ground. Plentiful in the mixed deciduous forests. Timber white and soft, of no special character; very little used locally, and is not durable.”

**Saccoglottis gabonensis**, Urban. Humiriaceæ. Gen. No. 909.

Synonym: Sometimes spelt in error “*Saxoglottis gabunensis*.”

**LOCALITIES.**—Sierra Leone, Ivory Coast, Nigeria, Gaboon.

**VERNACULAR NAMES.**—Amuan; Atala; Attalla; Edat; Mahogany; Ndat; Tala; Ugu; Ozouga; Ozougo; Esoua; Mosouhouga.

Description of the wood from a specimen, No. 3608 “Atala,” received from the Government of Nigeria (Lagos).

A hard and heavy wood of a purplish red colour resembling the East Indian “Eng.” Surface, dull; grain, medium, very much inclined and open for the most part; not cold to the touch. Shade of the transverse section slightly deeper than that of the other sections. Smell, none. Chevalier's description, “Uniform pale red; heartwood a little darker,” hardly accords. But he says elsewhere (1917, p. 87), “of a beautiful red.” Unwin says, “dark red.”

**STRUCTURE.**—*Transverse section.* (Prepared with glass-paper.)

Parenchyma of one kind only, sheathing the pores, but not

extending to wings, colour pale buff ; proportion of the wood about one-fifth.

Vessels not visible except by means of their parenchyma ; medium in size ; very irregular in distribution, being more or less crowded in some parts and widely isolated in others ; arrangement indefinite for the most part, but straggling, oblique, or serpentine lines may be discerned here and there. Number per mm. 6-14. Shape distinctly oval ; some globules of resin.

Rays visible only with the lens, very weak and fine ; of one kind ; regular in size and spacing and at intervals of about three times their own width ; number per mm. 10-14. Contents red, giving the rays that colour. Proportion of the wood nearly one-third.

Ground-tissue-cells visible in places with the macroscope ; proportion of the wood about one-half.

Rings apparently traceable, but very doubtful, the zones of denser tissue may indicate the boundaries ; contour very irregular.

*Radial section* very uniform in colour, relieved a little by the slightly lighter parenchyma. Grain, open, empty ; (the *scalariform perforations of the vessels are readily visible with the macroscope*, or even with a hand-lens). Parenchyma visible as hoary borders. Rays just visible by their darker red colour. Rings not indicated except by a faint striping.

*Tangential section* as the radial, but the rays are minute spindle-shaped lines of a distinctly red colour, not in parallel, being exceedingly irregularly distributed, multi-seriate, but not exceeding three rows of cells ; height up to about 15 cells.

Pith ? Sapwood not defined from the heartwood. Unwin says (l.c. p. 405), " slash red ; sapwood very narrow, yellowish-red."

BARK entire, falling away at length in very small scales ; colour silvery-grey, and of a rusty reddish brown (burnt sienna) within. Lenticels roundish with horizontal fissures, rather scarce and widely isolated. Texture exceedingly fibrous and coarse, the various layers of fibres being strongly inclined to each other. Fairly strongly adherent to the trunk. Bark in section of one layer and the epidermis ; colour uniformly brown ; scleroses small but very abundant (about half the substance) ; whitish. Weathers lighter brown.

Chevalier says (1917, p. 87), "Bark reddish-grey, wrinkled scaling in long flakes; thickness about 8-10 mm." Elsewhere (1909, p. 238) he describes it as being reddish-grey, deeply fissured and cut, scoriaceous and very thick" (1909, p. 168). Unwin (1920, p. 238) says, "used to put in wine to give it a bitter taste," and p. 405, "for making gin bitter." "It strips off cleanly from the tree and is sold in Calabar in rolls 30 inches long by 18 inches diameter" (p. 49). "Roughly fissured like that of Elm but more regularly"—"a reddish sap exudes when the tree is cut" (p. 405).

USES, ETC.—"Much prized by the native canoe-makers" (Empire Timber Ex. Cat., 1920, p. 250).

*Density*, No. 3608, 0.86 or about 54lb. per cu. ft.

Chevalier gives (1917, p. 87) 0.874.

**Klainedoxa gabonensis**, Pierre. Simarubaceæ (Thonner says Irvingiaceæ). Gen. No. 1111A.

LOCALITIES.—Nigeria, British sphere Cameroons, Equatorial West Africa, Gaboon.

VERNACULAR NAMES.—Alukon-raba; Ifainaki; Odudu; Zembi; N'Kondjo. Saleses, p. 22, under "*Klaineodoxa?*" gives the following: Adioumkue; Aquabo; and Kroma.

Description of the wood from two specimen, Nos. 3014 (Empire Timber Ex., 1920) and 3629 (from Oni) "Alukon raba," sent by the Government of Nigeria at different times and probably from different sources.

GENERAL CHARACTERS.—A hard and heavy wood of a light golden-brown colour striped with hoary patches of soft-tissue (parenchyma). Colour deepens but little on exposure. The wood has a distinct resemblance to the old-fashioned Partridge-wood (*Andira inermis*). Surface bright, the little lustre being due to the ground-tissue. Grain, fairly coarse and open, inclined, some pronounced zigzag tracery here and there. Cool and slightly greasy to the touch, but hardly likely to soil much. Shade of the transverse section a little darker than that of the other sections. Smell, none.

STRUCTURE.—Recalls that of *Lophira* (see p. 14), but on a smaller scale.

*Transverse section*. (Prepared with glass-paper.)

Parenchyma of two kinds: (a) easily visible to the unaided

eye, and (b) abundant in concentric, undulating lines connecting the pores, occasionally interrupted and anastomosing; width equal to about half the diameter of a pore; 3 per radial mm. at intervals of about two pore-diameters; distribution fairly even; proportion of the wood about one-fifth. Many crystals.

Vessels visible as perforations, medium, no appreciable diminution in size; number per sq. mm. 6-8; a tendency to an échelon arrangement; simple, or in radial groups of 2-4 pores, mostly the former; very few; widely isolated, only about ten to fourteen groups in the field of the macroscope. Shape, oval; colour, light.

Rays just visible, very fine; of one kind only; regular in size and spacing; rather weak and avoiding the pores; colour, nearly as pale as the P. (a); proportion of the wood from one-fifth to one-sixth. Number of rays per mm. 10-14.

Ground-tissue-cells hardly visible with macroscope; proportion of the wood rather more than one-half.

Rings undefined; contour regular.

*Radial section*.—Colour a hoary yellow (yellow and white in alternate lines and patches); grain, coarse, fairly straight, empty for the most part, but perhaps a little resin is present. P. (b) just visible as parallel, vertical, hoary lines, which by their closeness and abundance affect the tone of the section. Rays just visible by slight contrast of colour.

*Tangential section* as the radial, but the P. broadens out very much and becomes the feature of the section; the cells are visible with macroscope. Rays minute, mostly uniseriate; variable in size; not in parallel; their ends are hoary like the P.; height about 24 cells.

Pith, sapwood and bark absent from specimens.

*Density*, No. 3014, 1.125 or 70 lb. per cubic foot.

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*Conservator's note*.—"An evergreen tree found in the evergreen and mixed deciduous forests. Not very plentiful. Timber heavy and dense; very little used."

**Guarea sp.** Meliaceæ. Gen. No. 1178.

NOTE.—This is possibly *G. Thompsonii*. In the list supplied to us by the Chief Secretary of Nigeria the specimen No. 4 Benin (our 4035) appears under the heading of *Guarea Thomp-*

*sonii*, but below is called "*Guarea sp.*" The plank is marked "Sida," but this name is common to more than one species. The other species mentioned under the same heading (No. 13, Lagos) appears to us to be *Lovoa* (see that species).

VERNACULAR NAMES.—For *G. Thompsonii*: Akpaku; Cedar; Cedar-Mahogany; Close-grained Mahogany; Scented Mahogany; Obobonikwi; Sida; Sidu (both common to other species). For the other species mentioned by Unwin (1920, p. 329): Cedar Mahogany; Scented Mahogany; Sida; Sendar; Odogbo; Akokogbo; Obobonufwa; Akpaku.

Unwin's description does not accord very well with our specimen, inasmuch as the latter can hardly be said to resemble a Mahogany, and has not the characteristic smell stated by that author to be shared by both species mentioned by him.

Description from the specimen No. 4035 as above.

GENERAL CHARACTERS.—A wood of medium weight and somewhat hard, of a pleasing pale nut-brown colour relieved in tang. sec. by a pretty zigzag tracery in paler greyish-brown lines. Surface lustrous in patches, reminding one of satin-wood, and of beautiful effect; dry to the touch and rather cool. Grain, rather fine on account of the small number of the pores, very cross-grained with undulating fibres. Shade of the transverse section rather darker than that of the others.

STRUCTURE.—Fairly visible on trans. section; decidedly characteristic.

*Transverse section.* (Prepared with glass-paper.)—See Pl. II, fig. 4.

Parenchyma readily visible and abundant; of one kind only sheathing the vessels and extending into nearly continuous concentric lines, which are frequently undulating and anastomosing; irregular in width and at intervals of about twice their own width; number per mm. 2-4; colour very light buff; sometimes there is a narrow zone of fibres where the lines are lacking and the vessels very few. Proportion of the wood about one-third.

Vessels visible to the unaided eye as perforations, medium in size and regular; shape, *round*; very widely isolated and few and irregular in distribution, there being as many as 5 per sq. mm. in some places, while in others there are areas of more than a sq. mm. in which no vessels occur. Mostly single,

occasional pairs only. Contents, some amber and red globules.

Rays on the limit of vision, very fine ; of one kind ; regular in size and spacing, weak, often changing their direction slightly from zone to zone (question of growth ?). Number per mm. 7-8, width about 0.05 mm. ; at intervals of 2-3 times their own width. Proportion of the mass about one-quarter.

Ground-tissue cells visible with macroscope ; apparently contain crystals ; proportion of the mass rather less than half.

Rings : apparently well defined by zones of denser and less porous wood, contour very irregular (at least in specimen).

*Radial section.*—Shows much play of light as the specimen is turned. Rays visible as narrow hoary bands up to 0.5 mm. in width. The parenchyma appears as very numerous and close hoary lines, straight or undulating. Vessels very rare, mostly open ; linings shiny ; sometimes partially filled with globules in varying shades of amber.

*Tangential section.*—As the radial, but the rays are just visible as very fine spindle-shaped lines slightly less lustrous than the ground-tissue ; not in parallel ; height about 0.5 mm. or 12 cells, by 1-2 rows wide, mostly the former. Parenchyma as above very prominent in certain lights.

*Density*, No. 4035, 0.70 or about 43½ lb. per cubic foot.

Pith ? SAPWOOD ? Unwin says (1920, p. 328), "white."

Bark ?

Exterior of log under bark, smooth.

*Conservator's note* (on *G. Thompsonii*). "A large tree of the evergreen forest. The timber is known under the trade name of Cedar." Unwin (p. 328) says, "not termite-proof."

**Khaya grandis**, Stapf. Meliaceæ. Syn. *K. grandifolia*, Stapf., C.DC. (not *K. grandifoliola*, A.DC.). Gen. No. 1193.

**LOCALITIES.**—Nigeria, Ivory Coast, Congo.

**VERNACULAR NAMES.**—Akor ; Appapayi ; Asamogo ; Baffili (supposed to be this species, see Unwin, 1919, p. 28) ; Digiten ; Diki ; Dirinshi (Dirinshi Diki ?) ; Gadeau (com. to *K. Senegalensis*) ; Mahogany ; Mahogany, African ; Mahogany, Benin ; Mahogany, big-leaved ; Obon ; Odala ; Oganwo ; Ogwango ; Ogwangu (com. to three sp.) ; Upono ; Wansanwah.

**NOTE.**—Unwin cites the names of Krubua and Okunmankra in connection with an "Appapayayi" as a species of *Khaya*.

Our specimens bearing similar names do not agree with this species, though they are undoubtedly of the same genus.

Description of the wood from a specimen No. 3103 sent by the Government of Nigeria (Empire Timber Exhibition, 1920).

**GENERAL CHARACTERS.**—A wood of medium weight and hardness resembling a Mahogany of fair quality. Colour red or reddish-brown, inclining to pink when freshly worked; it deepens and improves on exposure. Surface bright on all cuts, dry, hardly likely to soil. Grain, coarse, open, exceedingly tortuous, and very roey. Shade of the transverse section much as that of the other sections. Smell, none.

**STRUCTURE.**—Resembles that of *Swietenia*.

*Transverse section.* (Prepared with glass-paper.)

Parenchyma of two kinds: (*a*) vasicentric, and (*c*) simulating the ring-boundaries.

Parenchyma (*a*) not visible to the unaided eye, needs lens as it lacks contrast of colour; very light pink; does not extend laterally to wings.

Parenchyma (*c*) occasionally visible without lens as fine concentric lines, but very difficult to see for the most part; width of lines about the radial diameter of a large pore; continuous; colour rather less pink than the P. (*a*).

Vessels readily visible as perforations, large, diminishing in size from the inner to the outer side of the ring and variable in number 2–7 per sq. mm.; widely isolated except in the inner zone of the ring where the pores are often collected into a quite definite pore-ring of rather larger pores (the only species of Mahogany in which we have seen this). Arrangement indefinite. Some twinned pores, but mostly simple; oval in shape. Contents black. Proportion of the wood, including Parenchyma (*a*), about one-fifth.

Rays readily visible from their red colour and size, fine, similar in colour to the P. (*a*); fairly regular in size and spacing; rather weak; intervals about three times the width of a ray; 4–6 per mm. Contents? Proportion of the wood about one-fifth.

*Ground-tissue-cells* readily visible with macroscope; colour, dull grey-brown; contents shine like minute beads.

Rings very ill-defined, boundaries traceable with difficulty, except at long intervals; contour regular.



*Radial section*.—Vessels appear as large grooves, sometimes twinned; contain much nearly black resin or gum. Parenchyma (*a*) very scanty, visible with difficulty with lens. P. (*c*)?, but there are certain lines heavily charged with gum that look like boundaries. Rays readily visible as small dull flakes, like pink chalk.

*Tangential section* as the radial, but the rays are only just visible as fine, short, pink lines producing a matt effect, being dull against the shining fibres of the ground; height about twelve cells, but very variable in both height and width; uniseriate rays not common, and up to six-seriate present; not in parallel; shape symmetrical, or only very slightly distorted; gum globules visible with macro. Vessels often oblique.

*Density*, No. 3103, 0.594 or about 37 lb. per cubic foot.

Bark, sapwood and pith absent from our specimen.

USES, ETC.—An excellent quality of Mahogany and suitable for all purposes to which that wood is usually put.

**Lovoa Klaineana** (Pierre MSS.), Sprague. Meliaceæ. Gen. No. 1198c.

NOTE.—The determination of the species is uncertain. A specimen received as "Apobo" or "Anamammilla" (*Pseudocedrela* sp.), No. 2904 HS., from Southern Nigeria, is certainly the African Walnut, best known to commerce. H. N. Thompson (1908, p. 90) says that "Apobo, African Walnut, or Anamammilla is a species of *Pseudocedrela*," and that the colour of the wood is "rich Walnut-brown." Unwin (1920, p. 100) cites a "Pebedum" as being *Lovoa Klaineana*, and describes the wood as "Walnut-brown, sometimes with striking black streaks," which tallies admirably with our specimens, the black streaks, produced by gum-galls, being unusual and a particularly characteristic feature. Specimen No. 3620, sent to us as *Guarea* from Benin, is so like this species that we hesitate to come to a decision. Amongst our specimens Nos. 1839 HS. "Enonee" from a commercial source, 1897 HS. "African Walnut," 1887 HS. "African Mahogany" agree with each other and are probably the same as our type. The last mentioned is a piece of the same wood with which the fittings of Emmanuel College, Cambridge (North Court) were made.

It is wonderfully effective, and it is surprising that this wood is not more largely employed. No. 4033 received from the Government of Nigeria (Benin) agrees with the above, but is poorer in colour, being greyish rather than golden. The concentric gum-galls are very marked, in some cases being of three rows deep. No. 3914 "African Walnut" from Cape Lopez also agrees, but is a coarser, more porous wood. The "Kwatinura," No. 2798 HS., collected by Capt. Armitage and labelled "*Lovoa klaineana*," and our specimens of "Penkwa" from the Gold Coast are quite unlike the type, and the "Kwatinru," No. 3028 from the G.C., is still more unlike and differs from the "Kwatinura" just cited.

LOCALITIES mentioned for *Lovoa*: Sierra Leone, Gold Coast, Liberia, French Gaboon (Congo française), Nigeria, Uganda.

VERNACULAR NAMES.—Akwantanuro; Abuwe; Anamam-milla (com. to Ubellu); Alone; Apobo; Apopo; Enonee; Ikwahobo; Kwantanuro (com.); Kwatenura; Pebedum; Pepedum; Penkwa (com. to *Entandrophragma* sp.); Walnut, African.

GENERAL CHARACTERS.—A comparatively light and soft wood resembling Mahogany as regards the grain, but not in colour, which in this case is golden brown of quite peculiar tint and lustre. Grain, medium, coarse and open, very cross. Much black in the bait and concentric resin-galls frequent, producing blackish lines here and there and enhancing rather than detracting from the effect. "Smell of Cedar" (Chevalier, 1917, p. 130). Shade of the transverse section perhaps a little lighter than that of the other sections. Not likely to soil.

Description from a specimen, No. 2904 from S. Nigeria, with which others, from commercial sources, agree.

STRUCTURE.—Resembles that of *Swietenia* and other Mahoganies.

*Transverse section.* (Prepared with broken glass.)—See Pl. IV, fig. 3.

Parenchyma of one kind only: (a) readily visible to the unaided eye on account of its light colour, sheaths the pores and not too narrowly, occasionally extending to concentric lines, which, though in some cases continuous, are for the most part short; width of lines about twice the breadth of a ray

or less; the lines occur chiefly in the denser tissue and are absent in some zones; in some rings festoons are formed.

Vessels visible on account of the P. (a) which sheaths them; rather small, but not diminishing in size outwards to the limit of the ring; slightly fewer in number in the outer zone; not very widely isolated, rather crowded in places; number of pore groups per sq. mm. 9-12; arrangement indefinite, except where there are festoons, and even then the angle of inclination to the radial line is quite indefinite; simple and in radial groups of 2-3 pores, the groups themselves inclining to dispose themselves radially, a disposition that is sometimes visible to the naked eye. Contents, black. Proportion of the wood, including the P. (a), about one-third.

Rays not visible except with the lens on account of their brown colour; and sometimes difficult to find; fairly regular in size and spacing; nearly straight and not avoiding the pores; intervals about 5-6 times the breadth of a ray; number per mm. 3-8. Proportion of the wood, about one-fifth to one-sixth.

Ground-tissue-cells just visible with macroscope.

Rings apparently defined, but less distinct with lens; boundaries may possibly be the bands of denser tissue; regular in contour; the gum-galls may follow the boundary.

*Radial section.*—Rays visible in certain lights only; in the right light they are readily visible on account of their lack of lustre. Vessels medium coarse, often twinned, with much black resin and shining linings. P. (a) just visible with lens as tails to the vessels, and an occasional white line visible in certain lights.

*Tangential section* as the radial, but the vessels exposed are fewer, though occasionally twinned. Rays need lens and are then visible as fine brown lines somewhat variable in size; not in parallel; uni- and multi-seriate; height up to twenty cells by one to three wide.

SAPWOOD of *Lovoa*.—"White, comparatively narrow" (Unwin, 1920, p. 327).

BARK of *Lovoa*.—"Dark brown, becoming rougher with age and scaling to some extent; yellow-brown and smooth when young" (Unwin, l.c.). "Greyish, wrinkled on the surface, but not fissured, scaling in small plates" (Chev., l.c.).

USES, ETC., of *Lovoa*.—"Canoes; the wood shrinks and

warps but little; it is attacked by termites" (Unwin, l.c.). The wood needs no other advertisement than the example of the fittings at Cambridge.

*Density*, No. 1887 HS., 0.467, or about  $29\frac{1}{4}$  lb. per cu. ft.

"	"	2904	0.496	"	31	"	"
"	"	4033	0.62	"	39	"	"
"	"	1897 HS.	0.465	"	29	"	"
"	"	1839 HS.	0.492	"	31	"	"
"	"	2725	(received as Tasmanian Walnut !!)				
"	"	3620	(received as <i>Guarea</i> ) 0.54 or about 34 lb.				
			per cu. ft.				

(NOTE.—The difference in density is considerable in some cases, which fact may point to a mixture of species, but the difference is not greater than most species may at times present). Chevalier (l.c.) gives 0.514.

***Pterocarpus tinctorius***, Welwitsch. Leguminosæ: Papi-  
lionaceæ. Gen. No. 1837.

NOTE.—There is great difference in the various specimens reputed to be of this species, that we have seen. Our description is from one received from the Government of Nigeria (Benin, our No. 3623), but another kindly lent to us by Mr. Unwin, which agrees with a third (our No. 1992 HS.), though similar in structure, is so very much lighter in weight that we feel sure that it cannot be of the same species. Mr. Unwin vouches for the identity of his specimen, so we append a description of this. Holland says that Camwood is easily distinguished from Barwood by the fact that the former sinks in water, whereas Barwood floats. Our specimen of Camwood (*Baphia nitida*) sinks like a stone, and No. 1992 would probably float even when freshly felled, so according to Holland's test would be Barwood, but No. 3623 occupies an intermediate position, floating when dry, though it would certainly sink when green.

Unwin (1920) does not mention *P. tinctorius* in his list of Nigerian species (pp. 272–275), but on p. 31 he refers to it as the "South Nigerian Camwood." As much confusion has arisen between the Barwoods and Camwoods, we propose to confine the former name to species of *Pterocarpus* and Camwood to *Baphia*. The name "Barwood" doubtless covers the

woods furnished by *P. Osun* and *P. esculentus*. According to Welwitsch the present species *P. tinctorius* provides a part of the dye-powder used by the natives under the names of Hula, Tacula, Lucula and N'gula, and the rest is furnished by *P. Cabrae*. We have tested this powder and find that it does not give the same reactions as any of our specimens. From the *Kew Bulletin* of 1906, p. 373, we learn that a part of the Barwood of commerce is from *P. Soyauuxii*.

VERNACULAR NAMES associated with *P. tinctorius*.—Auchi; Bendwi (com. to other species of *Pter.*, to *Baphia*, and *Morinda citrifolia*). Barwood (com.); Bendwi; Bundwi (com.); Igo; Mubiri; Muangue; Nkohen; Oigo; Osun (com.); Padauk, African; Redwood; Uhie; Ukpa (com.); Ume (com.); Tacula; Lucula; Hula. "Muege" is mentioned by Hopkinson in connection with *P. Soyauuxii*, Taub.

GENERAL CHARACTERS.—A hard and heavy wood of a very rich deep red colour, almost crimson, relieved by slightly lighter and hoary zigzag lines. Grain, coarse, open, very much inclined (cross-grained), producing a very strong roey appearance on the quarter. Surface clean, rather cold to the touch, dry and not likely to soil; weathers to a chocolate-grey. Shade of the transverse section darker than that of the other sections. Strongly resembles the Andaman Padouk.

STRUCTURE.—Very clearly visible on trans. sec., resembles that of other *Pterocarpus* spp.

*Transverse section.* (Prepared with glass-paper.)—See Pl. II, fig. 2.

Parenchyma of one kind, sheathing the vessels and extending laterally into slightly undulating, practically continuous, concentric lines, occasionally anastomosing, very readily visible and light in colour; at intervals of about 2–3 times their own width, and varying in width from about half the short diameter of a large vessel to hair-like lines a little thicker than the rays; number per mm. 3–5; mass about one-third. (Perhaps there is an occasional boundary-line)

Vessels readily visible as perforations, very large, very widely isolated, there being areas of wood-fibres of 2–3 sq. mm. without a single vessel; great variation in size, especially in the groups, which are very characteristic, being radially disposed and containing up to sixteen large and small vessels, the smaller

often being twinned, especially on the bark side. General arrangement of the vessels indefinite. Shape oval for the most part, but the larger almost circular. Contents, a little red deposit.

Rays visible with lens with difficulty, extremely fine, of one kind only; very regular in size and spacing, at intervals of about 3-4 times their own width apart, or about 14 per mm. Proportion of the mass about one-sixth.

Ground-tissue deep in colour and horny; about one-half the whole mass; cells not visible with macroscope.

Rings not indicated, unless the dense zones of nearly poreless wood, which occur at fairly regular intervals, mark the boundaries.

*Radial section.*—The rays appear as minute flakes (on limit of vision with unaided eye), slightly darker than the fibres. Vessels very coarse, nearly empty, shining grooves. Parenchyma appears as extremely thin, hoary, vertical lines.

*Tangential section* as the radial, but the rays are extremely minute lines in parallel, the rows being scarcely visible to the naked eye, and about four to the mm., i.e. they are about 0.1 mm. high, and at intervals of rather more than their own height.

SAPWOOD exceptionally well defined from the heartwood; dirty white in colour and about  $2\frac{1}{2}$ -3 inches wide. The parenchyma becomes coloured a little in advance of the other elements. Pith? Bark?

*Density*, No. 3623, 0.81, or about 51 lb. per cu. ft.

(Cf. „ 1992 0.753 „  $46\frac{1}{2}$  „ „ )

USES, ETC.—Dyeing. The wood ought to sell on its merits as an easily-worked wood of rich colour, quite apart from its tinctorial properties.

The N'Gula powder from the Gaboon from a sample from the Musée Colonial de Marseille (No. 169, Gabon), when mixed with water (hot or cold), makes a rather dirty purplish-brown extract, but on the addition of soap, the wood in suspension falls and leaves the solution nearly clear. With alcohol the powder forms a rich orange tincture which on evaporation leaves a purplish residue. Both of our specimens fail to yield any coloration with distilled water and with potable water

(boiling) yield a pale sherry colour. With alcohol they yield a pale orange tincture with an orange-coloured residue.

Unwin (l.c. p. 10) says that the ground-up dye of *P. tinctorius* is preferred by the natives of S. Nigeria to that of *Baphia nitida*, the true Camwood, though supposed in England to be the inferior article.

*Conservator's note.*—"A medium-sized, straight-growing tree of the evergreen forest. The timber is of a beautiful rich red colour. Fairly plentiful in the Oban Country. Used as a dye by the natives and also for canoes."

Description of alternative specimen "Ukpa" (Efik) kindly lent to us by Mr. Unwin. Our No. 1992 HS., from commercial sources, agrees.

**GENERAL CHARACTERS.**—A rather light but hardish wood of a rich red, somewhat purplish, colour, resembling an inferior quality of Andaman Padauk. The colour deepens and fades considerably; weathers silvery. Surface clean, dry, not cold to the touch. Grain, coarse, open and slightly inclined. Shade of the transverse section slightly darker than that of the other sections. Smell, none. Floats in water.

**STRUCTURE.**—Resembles that of all species of *Pterocarpus*, or of *Lophira* (p. 14) on a small scale.

*Transverse section.* (Prepared with glass-paper.)

Parenchyma of one kind: (a) readily visible to the naked eye, arranged in almost continuous lines which anastomose occasionally, width about equal to that of the spaces between the rays, or rather more, and about 3–6 times their own breadth apart, 2–3 per mm.; more abundant in the outer zone of the ring; colour, orange-red; proportion of the wood, about one-quarter. The cells contain resin globules.

Vessels visible on account of their parenchyma (a) and occasionally as perforations; large, diminishing little if at all outwards to the ring boundary, but rapidly increasing in size as the tree ages; a slight tendency to arrange themselves in oblique lines apart from the P. (a); number per sq. mm. 0–3; very widely isolated; simple or in groups of 2–5; proportion of the wood not one-twentieth.

Rays just visible with lens; of one kind only; red, slightly darker than the parenchyma (no orange); fairly regular in size and spacing and about their own width apart; weak and

too thin to taper appreciably; number per mm. 22-24; proportion of the wood about one-quarter; cells contain globules.

Ground-tissue-cells doubtfully visible with the macroscope.

Rings apparently defined by bands of very dark dense tissue; contour regular.

*Radial section*.—The P. (a) in light lines is readily visible. Vessels frequently forked and in some cases a pore will branch like the cross-over road of a railway. They are mostly empty with bright linings, and a little resin here and there. The rays produce a matt effect which is just discernible, the individual rays being just visible with the lens.

*Tangential section* as the radial, but the P. (a) broadens out into prominent hoary loops. The branching of the vessels is still more obvious and some are very crooked. Rays visible with lens, very minute, in parallel and similar in height (about ten cells), or as long as the diameter of a large vessel.

*Density*, 0.74 to 0.753, or about  $46\frac{1}{2}$  lb. per cubic foot.

**Paradaniellia Olivierii**, Rolfe. Leguminosæ: Cæsalpineæ.  
Gen. No. 1949A.

Synonyms: *P. thurifera*, Oliv.; *Daniella* (or *Daniellia*) *thurifera*, Oliv. (non Benn., which = *Cyanothyrsus*, but which now according to Stapf should form the new genus *Afrodaniella*. See Chevalier, 1917, p. 164).

LOCALITIES.—Sierra Leone, Gold Coast, Togo, Nigeria.

Our specimens were sent to us under the name of *Daniella Olivierii*, hence we give vernacular names separately. Another received as *Daniella thurifera*, J. J. Benn, No. 4301 HS. "Bu" from the Sudan, agrees except as to colour, which is distinctly redder.

VERNACULAR NAMES.—For *Paradaniellia*: Balsam; Balsam of Copaivi; African or Ilorin Balsam; Balsam Copaiba-tree; Dunchi; Gbassei; Iya; Kadaura; Kpesssei; Mage.

For *Daniellia thurifera*, Benn: Awolo; Bessi; Dsati; Kenjang; Lipiti; Masche; Orokpo; Osia; Ozia (c); Osaba; Oyiz; Sa; Sainja; Tschato.

For *Daniellia thurifera*, Benthaim (is this an error? see Volken, 1909, p. 12): Auwolo; Dsati; Kenjang; Liptii; Masche; Orokpo; Sa; Sainja.



For either species (not specified): Abo-Ogea; Ako-Ogea; Balsam; Boo; Bu; Bubalinabo; Iya Odan; Kadaura; Katlahi; Karon-maje; Maji; Ogeagum (i.e. Ogea-gum); Santang; Thievi; Wood-oil-tree.

Description of the wood from a specimen, No. 3002 "Iya," received from the Government of Nigeria (Empire Timber Exhibition, 1920).

GENERAL CHARACTERS.—A comparatively soft and rather light wood about as heavy and hard as the European Alder, and of a reddish-brown colour with some darker (colder) coloured striæ. Surface darkens but little on exposure, dull on account of the half-tone effect produced by the rays in tangential section; not cold to the touch; might soil, but would not show the dirt. Grain, coarse, open, oblique. Shade of the transverse section somewhat lighter than that of the other sections. Smell, none.

STRUCTURE.—Resembles that of *Afzelia* and *Brachystegia* of this series.

*Transverse section.* (Prepared with glass-paper.)—See Pl. II, fig. 3.

Parenchyma of two kinds: (*a*) vasicentric and (*c*) simulating the ring-boundaries.

Parenchyma (*a*) readily visible to the unaided eye, sheathing the pores in broad patches of a rhomboidal or lozenge-shape, which are often winged laterally, sometimes joining the pores to concentric lines; easily visible and giving the lighter tone to the section; proportion of the wood from one-fifth to one-quarter. P. (*c*) not readily distinguishable from the P. (*a*); in fine concentric lines readily visible in the denser zones; colour very little lighter than that of the rays; width 2-3 times that of a ray.

Vessels readily visible as perforations, large, uniformly distributed except in the zones poor in pores; arrangement if oblique then not very definite; 0-4 per sq. mm.; simple, and less frequently in radial m-and-d groups, twinned or nested groups being rare (radial groups 2-3 pores, nests 3-6); shape, oval; contents brown, not abundant.

Rays visible with difficulty, fine, of one kind; lighter in colour than the ground, but darker than the P. (*a*). Somewhat irregularly spaced, more numerous in places, sometimes exceed-

ing the ground-tissue in area, being less than their own breadth apart (rare case), never widely spaced (up to 3-4 to a pore-diameter). Very variable in thickness, with a suggestion of false aggregation here and there. Where a ray crosses a line of P. (a) there is a distinct arching or crenation of the line and a suggestion of a node in the ray. Number per mm. 8-14; somewhat weak, but if they avoid the pores, this avoidance is masked by the P. (a). Proportion of the wood about one-third.

Ground-tissue-cells just visible with the macroscope, especially in parts of the wood which are tainted by decay. The cells are regularly arranged in rank and file (rare case amongst Dicotyledons).

Rings apparently defined by a line of P. (c); contour regular.

*Radial section*.—P. (a) and P. (c) both clearly visible. Vessels coarse, but not prominent from lack of contrast; loculi visible to the unaided eye; contents, red, scanty. Rays visible by contrast of lustre.

*Tangential section* as the radial, but the rays appear as minute lines, which being in parallel produce a fine stippling that even attracts the eye, it is very pronounced on the sapwood (see fig. 10, Pl. I). Height of rays very uniform, up to about ten cells by 1-4 wide arranged in horizontal rows of some three rows to the mm. Vessels very irregular in their course, but there is no zigzag tracery.

*Density*, No. 3002, 0.608, or about 38 lb. per cubic foot.

*SAPWOOD*.—Colour, oatmeal; sharply defined from the heartwood; contour regular. The rays become coloured before the rest of the tissues. On a trans. sec., this feature produces a distinct zoning.

Pith? Bark?

***Afzelia africana***, Persoon.

Leguminosæ: Cæsalpineæ. Gen. No. 1951.

Syn.: *Intsia Africana*, O. Kuntze.

*LOCALITIES*.—Senegambia, Upper and Lower Guinea, Sierra Leone, Gold Coast, Togo, Nigeria, Gaboon, Congo, Uganda, Rhodesia, British East Africa (Malindi district), Cameroons, French Central Africa.

VERNACULAR NAMES.—Adja; Adya; Appaka; Aligna; Apa (not Apa oro); Arachi; Ayibukpo; Ayin-bukbo; Baa; Bamba-kofi (com.); Bendiguri (com. to *A. bracteata*); Bilenga (trade name on Fr. Congo; and Bilinga, com. also to *Sarcocephalus*); Contah (com. to *A. bracteata*); Counter-wood (com.); Fasa-daga; Gongona; Ikpami; Kao; Kauwo; Kawo; Kebarra; Konta (com.); Kontah; Kpakpa; Kpendi-deli; Mahogany; Mahogany, African (com.); Mahogany, Rhodesian (com.); Mahogany-bean; Mandji (com. to *Sarcocephalus*); N'Kokongo; Oak, African (Unwin, 1920, p. 179); Olokokima; Opapao (com.); Papao (com.); Papaobaum; Papau; Papow; Sifu Sifu; Welu; Yoruba Bilinga.

Description of the wood from a specimen received from the Government of Nigeria, No. 3102 "Apa" (Empire Timber Exhibition). Our specimens, No. 0740 HS. "Bamba-kofi" from the Malindi District, British East Africa, No. 3095 (McDonald) from the Gold Coast, agree, but Nos. 2823 "Opepea" from the G.C. sent as this species does not, nor does No. 3797 "Bilinga" from a commercial source. No. 3018 "Papow; Papao" from the G.C. (Empire Timber Exhibition) is very close if not the same wood. We include a description of No. 2823 as it may possibly be correctly identified. (See p. 40.)

GENERAL CHARACTERS.—A rather heavy, hard wood of a golden-brown colour streaked with darker and lighter zones and showing a feather-like tracery in tangential section. Colour deepens considerably on exposure: "Rich Oak-brown" (Unwin, 1920, p. 292). Grain, moderately coarse and open, a little inclined (cross). Surface not cold to the touch, dry. Shade of the transverse section a little lighter than that of the others, there being much pale soft-tissue (parenchyma). Smell, none. Not likely to soil.

STRUCTURE.—Resembles that of many leguminous woods such as Mora.

*Transverse section.* (Prepared with the plane.)

Parenchyma of two kinds: (a) vasicentric and (c) simulating the ring-boundaries.

Parenchyma (a) readily visible, abundant, giving the light tone to the section, sheathing the pores, forming for the most part lenticular patches, and extending obliquely and joining up 2-5 pores or pore-groups; also in a concentric direction,

but then in fine lines about equal in width to one-quarter of the diameter of a large pore. Proportion of the wood, about one-third.

Parenchyma (*c*) in very fine concentric lines, occasionally repeated many times, which are just visible. The more continuous lines run in a zone which is poor in pores. Colour similar to that of the rays; width from that of a ray to twice that width. In the middle zone of the ring these lines are discontinuous and occur at irregular intervals.

Vessels easily visible as perforations, large, uniformly distributed (except in the zone poor in pores), widely isolated, 5-7 per sq. mm., but areas of a sq. mm. without a pore. Sometimes in oblique lines united by P. (*a*). Often simple, but mostly in nested groups, less frequently in radial groups, threes are common and fours occur. Shape, oval; contents, white, and a little red gum.

Rays visible with difficulty with the unaided eye, but readily with lens; of one kind only; colour yellow, slightly darker than that of the P. (*a*); very regular in size and spacing, two or three to the smaller diameter of a large pore; 9-12 per mm. Proportion of the wood, about  $\frac{1}{4}$ .

Ground-tissue dense; cells visible with the microscope.

Rings apparently well defined by the denser bands of wood; no certain boundary; contour regular.

*Radial section.*—Surface clean with lighter and darker bands of colour. Vessels very prominent, coarse, inclined, open, but with an amorphous buff or white deposit here and there and some red globules.

Parenchyma (*a*) very distinct, giving the tone to the lighter wood and appearing as borders and tails to the pores. P. (*c*) visible with attention. Rays very fine, but yet visible by their lustre as minute flecks.

*Tangential section* as the radial, but the P. (*a*) broadens out and forms a sort of "partridge-feather" design. The P. (*c*) also appears quite distinctly. Rays just visible as a matt effect and are individually visible with lens; height about eight to fourteen cells by one to two cells wide, the latter being rare; not in parallel.

SAPWOOD "white" (Unwin, l.c.). "Yellowish-white" (Comte de B., p. 151).

**BARK:** "Drops off in large scales towards middle age, in a similar fashion to the European Plane. However, they do not leave the stem as smooth, though the lighter patches where the bark falls off brighten the bole up and make it quite distinctive" (Unwin, p. 293). "Bark greyish-brown" (Comte de Briey, ex. de Wild, 1920, p. 145).

**USES.**—"Mortars" (Unwin, p. 159). "One of the most durable of the African timbers" (p. 292).

Jumelle and Pierre (p. 111) say, "the wood was exploited in the Cameroons, and its light colour was the cause of the fall in price of the common Mahoganies on the Liverpool market."

*Density*, No. 3102, 0.891, or about  $55\frac{3}{4}$  lb. per cu. ft.

" " 3095, 0.825 "  $51\frac{1}{2}$  " "

*Conservator's note.*—"A large tree plentiful in the intermediate forest and found in the evergreen forests. Timber hard and durable, suitable for solid doors, stair-treads and general joinery."

Alternative description, from a specimen, No. 2823 "*Opepeh*; *Opepea*," from the Gold Coast, received as *Afzelia africana*, Sm.

**GENERAL CHARACTERS.**—A rather hard and heavy wood of a colour rather resembling that of Red Pine, being reddish striated and striped with hoary parenchyma. Surface clear and dull by bands; dry, rather cool to the touch, rather liable to soil. Grain, very coarse, open; the pores are very large and very few. Shade of the transverse section darker than that of the other sections. Smell, none.

**STRUCTURE.**—Very characteristic and evident.

*Transverse section.* (Prepared with glass-paper.)

Parenchyma of one kind only: (a) in broad, conspicuous, concentric, light-coloured bands embedding and uniting the pores, often anastomosing; colour buff; width about 1 mm.; at intervals of about their own breadth, or rather more; proportion of the wood about two-fifths to one-half. The parenchyma has the appearance of having been roved out or combed into the ground tissue. Vessels readily visible as perforations, large, not diminishing in size (except in the groups); simple and in groups of two to five, rarely the latter; distribution indefinite; very few, 0.5 per sq. mm., widely isolated, as much as 3 sq. mm. being without a vessel; oval; contents, a few pale

globules; proportion of the wood (excluding the Parenchyma) very small.

Rays just visible to the unaided eye on account of their light colour, small; of one kind only; slightly nodose where they cross the bands of parenchyma; fairly regular in size and spacing; intervals about four times the width of a ray; number of rays per mm. 6-8; colour, pinkish and rather darker than the parenchyma. Proportion of the wood about one-fifth.

Ground-tissue-cells just visible with the macroscope; colour, dark brown and horny. Proportion of the wood rather less than one-half.

Rings: No certain indication.

*Radial section*.—Vessels very rare, coarse, often twinned and even in fours side by side, occasionally strongly bent or curved; contents scanty, mostly masked by the parenchyma. Parenchyma very easily visible, composing half the surface in long, parallel, buff-coloured lines. Rays readily visible flakes, not contrasting very much with the parenchyma, but rather more with the ground tissue.

*Tangential section* as the radial, but the rays are too small to be visible with the unaided eye except as a slight matt effect; not in parallel; very variable in height and width; 1-4 rows wide (mostly two-seriate) and very thin for their height, which may run to more than  $1\frac{1}{2}$  mm.

*Density*, No. 2823, 0.804, or about 50 lb. per cubic foot.

### ***Brachystegia spicæformis*, Benth.**

Leguminosæ; Cæsalpineæ. Gen. No. 1955.

LOCALITIES.—Gold Coast, Liberia, Togo, Nigeria, Lower Guinea, Angola, Mozambique, Zanzibar.

VERNACULAR NAMES.—Agberigeddi; Ake; Akpanya (not Akpwanian); Akpakpa; Casca-pano (the fibre); Chenga (of Livingstone); Eku (com. to *Ricinodendron* and *Daniellia*); Etare; Ikpanya; Ille; Ille pagini; Macarara; Mapondo; Marotta; M'chenga; M'cheng'a; Mecombo; M'nenga; Mpangu; M'tamba; Mupanda; Mupondo; Npanda; Ochwan; Okwan; Okwen; Okwein (com. to *Ricinodendron* and *Daniellia*); Panda; Pao ferro; Tondo; Tzontzo; Ukung; Umpanda; Ungu.

Description of the wood from a specimen, No. 3003 "Ake,"

sent by the Government of Nigeria (Empire Timber Exhibition, 1920). Our specimen No. 2763 HS. "Ochwen" from South Nigeria agrees, but No. 2848 "Akwania," from the same colony, does not.

GENERAL CHARACTERS.—A comparatively light and rather soft wood of a light brown colour striped light and dark, the difference in the shade being due partly to bands of varying density and partly to cross-grain. Some feather-like tracery is to be seen on the tangential section, but it is not very prominent. Grain, coarse, open, slightly inclined. Transverse section darker in shade than the others. Not cold to the touch, nor likely to soil. Smell, none. Unwin says (1920, pp. 68 and 277), "Very pretty grain . . . with almost evenly distributed streaks of darker brown."

STRUCTURE.—Resembles that of *Azelia africana* No. 3102 of this series, p. 37.

*Transverse section.* (Prepared with glass-paper.)—See Pl. III, fig. 2. Parenchyma of two kinds: (a) vasicentric and (c) simulating the ring-boundaries.

Parenchyma (a) easily visible to the unaided eye, giving the light tone to the section; sheathes the pores, forming broad patches of a rhomboidal or lozenge shape and joining 2-5 pores or pore-groups. The lines which join the pores are more concentric than oblique. Proportion of the wood, about one-fifth.

Parenchyma (c) in fine concentric lines that are visible to the unaided eye. They are sometimes repeated and are more continuous in the denser zones that are poor in pores. Colour lighter than that of the rays; width about that of the intervals between the rays.

Vessels very easily visible as perforations, large, uniformly distributed (except in the dense zones); widely isolated, 0-3 per sq. mm. Arranged in oblique lines as already stated. Simple and in both nested and radial groups of 2-8, three frequent. Contents, a light-coloured amorphous substance, little if any gum or resin, but certain dried-up brown masses.

Rays not too easily visible with lens, very fine; of one kind; colour brown between that of the P. (a) and that of the ground. Very regular in size, but less so in spacing, at intervals equal

to half the diameter of a large pore; somewhat weak and widely avoiding the pores. Proportion of the wood very small. Number per mm. 10-14.

Ground-tissue of varying density, but for the most part the cells are just visible with the macroscope. They are apparently in parallel concentric zones.

Rings apparently defined by the denser bands; the boundary is perhaps indicated by a more prominent line of denser tissue; contour regular.

*Radial section.*—Parenchyma (*a*) quite distinct as borders and tails to the pores, but it does not give the tone to the section. P. (*c*) visible with attention. Vessels very prominent; contents as above. Rays very fine flakes, which are visible by reflection on careful search.

*Tangential section* as the radial, but the rays are minute lines in parallel, causing a fine stippling which is visible to the unaided eye. Height of rays about fifteen cells by one wide. Vessels conspicuous as open grooves which show a tendency to a zigzag tracery (but not to "partridge-wing figure").

SAPWOOD "white" (Unwin, l.c. p. 277).

BARK—"Rough, scaly. A hard brownish gum exudes from the tree when cut and hardens to a reddish, opaque mass" (ibid. l.c.). "A red juice exudes" (Oliver, II, p. 306).

USES, ETC.—Public works (Unwin, p. 28); very durable, but the sapwood soon rots on exposure to the weather (p. 277).

*Density*, No. 3003, 0.575, or about 36 lb. per cu. ft.

" " 2763, 0.622 " 39 " "

*Conservator's note.*—"A large tree with a very big spread of branches, growing chiefly on the banks of rivers and streams."

**Erythrophleum guineense.** G. Don. Leguminosæ: Cæsalpineæ. Gen. No. 1976.

*Synonym.*—*Fillæa suaveolens*, Guill. et Pierre.

LOCALITIES.—Gambia, Sierra Leone, Gold Coast, Ivory Coast, Togo, Nigeria, Congo, Cameroons, French Central Africa, Gaboon, Dar es Salaam, Mozambique, Cape of Good Hope.

VERNACULAR NAMES.—Akpa etuidiwi; Arache, or Arachi;



Arhoné or Aronhe; Atiema; Baŋgi; Bourane; Casca-bark-tree; Ebondo; Elégué-mouani; Ellondo; Ellong; Erhoné; Erum obo; Erüi or Erui; Erun (or Obo); Eyo; Gli; Gouda; Guié; Haya; Ibo (Unwin, 1920, p. 275); Inyi; Kaša; Kbandé; Kura; Kekeu; Lo; Meli; Mwavi-bark; Nguié; N'kassa; Obo; Oginyi; Omuvumvu; Ordeal-bark; Poison d'épreuve; Potrodon or Protodon; Red-water-tree; Sassa; Sasswood; Talli; Tali; Tia; Tsa; Tele, *Telé* or *Téli*; Sassy-bark; Eloun; Elondo; Eyo.

Description of the wood from specimens Nos. 3292 "Erun" and 3264 both from Oni, received from the Government of Nigeria. Our specimen No. 3336 "Mwabwi" from Nyasaland, sent as being this species, does not agree, nor does No. 2199 HS. "Omuvumvu" from Uganda. Inasmuch as all differ from each other we accept the first mentioned provisionally, more especially as the last is nearly allied. (See also p. 46.)

GENERAL CHARACTERS.—A very heavy and hard wood of a light brown colour with paler, somewhat hoary bands or stripes. Unwin (l.c. p. 276) says, "dull red-brown." Harms (1911, p. 34) says, "at first white, afterwards brownish-red." Colour deepens a little on exposure. Surface bright, cold to the touch, not likely to soil. Grain, coarse, open, exceedingly cross-grained. Smell, none.

STRUCTURE.—Recalls that of *Afzelia* (see p. 37).

*Transverse section.* (Prepared with glass-paper.)—See Pl. III, fig. 3.

Parenchyma of one kind only: (a) vasicentric, visible to the unaided eye, sheathing the pores and extending laterally to wings. Rarely joining up adjacent groups except in the denser tissue, where it may join as many as five groups or even long series of pores concentrically; colour, oatmeal. Patches apparently unconnected with a vessel occur in the dense wood, and the amount of this tissue decreases materially as the tree ages.

Vessels visible as perforations, large, diminishing slightly in size outwards towards the ring-boundary, but they apparently decrease in size as the tree ages; not decreasing in numbers; 3-4 per sq. mm. A strong tendency to oblique lines, but by no means everywhere. Simple or in groups of 2-4 pores, mostly threes, but fours not uncommon; shape, roundish;

contents, amber and red. Proportion of the wood, including P. (a), about one-quarter.

Rays visible with lens, very fine; of one kind only; colour, dark amber; regular in size, but not in spacing; tending to avoid or run round the vessels; intervals vary from about twice the thickness of a ray up to twice a pore-diameter; weak; thin ends fairly numerous. Number per mm. 12-16. Proportion of the wood, about one-fifth.

Ground-tissue-cells not visible with the macroscope.

Rings apparently well defined to the unaided eye, but less so with lens; boundary, a line of contrast between laxer and denser zones; contour regular.

*Radial section*.—Rays just visible as minute brown lustrous flecks rather darker than the ground. Vessels often twinned, containing small quantities of resin. P. (a) visible as hoary borders and tails to the vessels, or, sometimes, with macroscope, as transparent veils over the latter. Rings not traceable except by the roey appearance of the grain.

*Tangential section* as the radial, but the amber contents of the vessels and also the parenchyma are more readily visible. Rays just visible as a matt effect, brown, in parallel or in échelon; height about ten cells by 1-3 wide.

SAPWOOD.—“Dull yellow” (Unwin, l.c.). “Reddish white” (Chevalier, 1909, p. 179).

BARK.—“Dark brown, thick, scaling off to a slight extent in old age” (Unwin, l.c.). “Light grey to dark brown, fissured” (Harms, l.c.). “Grey, wrinkled, scaling in small plates and red in colour within” (Chev., 1919, l.c.) and (1917, p. 179) “Greyish-white, finely fissured longitudinally, falling away in little scales; thickness about 10 mm.; reddish-brown in section.”

*Density*, No. 3292, 0.929, or about 58 lb. per cu. ft.

“ „ 3264, 0.91 „ 57 „ „

“ „ 3294, 0.89 „ 55½ „ „

“ „ 2997, 0.96 „ 60 „ „

Holland gives 0.876 and Chevalier 0.821 (1909) and 0.910 (1917, p. 179) and again 0.639 (p. 182).

*Conservator's note*.—“A large tree fairly plentiful in the mixed deciduous forest. Another species is found in the ever-green forests. The timber, which is hard and does not float, is

durable and suitable for bridge-building, decking, etc. It is not eaten by termites; the natives sometimes use it for canoes. The bark is very poisonous."

**Erythrophleum guineense.** Guill et Pierre.

Cæsalpineæ. Gen. No. 1976.

Alternative description from a specimen, No. 2997 from Uganda, collected by Mr. M. T. Dawe.

**GENERAL CHARACTERS.**—A very heavy and hard wood of a red colour inclining to crimson (distinctly crimson on the transverse section), somewhat striated with rather lighter lines. Colour deepens considerably on exposure. Surface clean, and slightly cold to the touch; not likely to soil. Grain, coarse and open, but somewhat oblique.

**STRUCTURE.**—Recalls that of *Afzelia*.

*Transverse section.* (Prepared with glass-paper.).

Parenchyma of one kind only: (*a*) vasicentric, visible to the naked eye, extends laterally into lozenge-shaped patches around the vessels, rarely joining two groups; colour pink. Patches of P. (*a*) unconnected with the vessels, absent.

Vessels visible as perforations by reflected light, large, diminishing a little in size from the inside to outside of the ring; not diminishing in numbers; number per sq. mm. from 2-3, rarely the latter. Arrangement in oblique lines. Simple or in groups of 2-4 vessels, mostly nested. Shape, distinctly oval. Contents, apparently nil. Proportion of the area (including parenchyma), from about one-sixth to one-fifth.

Rays visible with lens (in heartwood), more obscure in the sapwood, very fine; very uniform in size and spacing; colour, pink; straight. Number per mm. 14-16. At intervals of three to four times their own width, sometimes as many as six to the width of a large pore. Proportion of the tissues about one-sixth.

Ground-tissue-cells not visible with macroscope; horny and crimson-red in colour; occupying nearly two-thirds of the area of the section.

Rings apparently vaguely defined by zones of somewhat denser tissue; contour, regular.

*Radial section.*—Vessels, medium coarse, empty. Paren-

chyma obscure, just visible as tails to the pores and borders. Rays visible by reflection as dark lines, but invisible in certain lights.

*Tangential section*.—As the radial, but the rays need microscope; not in parallel; white as though crystalline and up to about ten cells high, or 0.15 to 0.2 mm., mostly if not all uniseriate.

Pith?

**SAPWOOD**.—Oatmeal colour, striated with reddish lines (the vessels, which colour before the other tissues); width about  $2\frac{1}{4}$  inches, well, but not sharply defined from the heartwood.

**BARK**.—Reddish brown, about 6 mm. thick, hard and granular in texture, nearly the same throughout; with many rather large scleroses, which in the outermost layer form a nearly continuous ring. A thin layer of oatmeal-coloured bast with darker brown longitudinal flecks, within.

**Cylicodiscus gabunense**, Harms. Leguminosæ: Mimosææ.  
Gen. No. 1976A.

*Synonym*.—*Erythrophleum gabunense*, Taub.

**LOCALITIES**.—Gold Coast, Calabar, Nigeria, Cameroons (British sphere).

**VERNACULAR NAMES**.—Adadawa; Aja; Agaiji (com. to *Piptadenia*); Aga-iji (com.); Ajumkobi; Akan; Anyan; Denya (com. to *Pip.*); Edum; Greenheart; Greenheart, African; Iji; Mbeli-deli; Odenya (com.); Okan; Olosan; Osho.

Description of the wood from a specimen, No. 3011 "Okan" (Empire Timber Exhibition, 1920), received from the Government of Nigeria. Our specimens Nos. 2802 HS. "Denya; Odenya" from the Gold Coast, 2765 HS. "Okan; Greenheart" from South Nigeria, 1891 HS. "Greenheart" and 1846 HS. "Mahogany" from commercial sources, all agree.

**GENERAL CHARACTERS**.—A rather hard and heavy wood of a metallic greenish or golden colour, or even brown, striped with light and dark zones here and there. It appears to be very variable in weight. Surface beautifully lustrous, the effect being due to refraction of light by the cells. Grain, open, coarse, much inclined. Rather cool to the touch. Shade of the transverse section distinctly darker than that of the

others. Smell? Not likely to soil. The colour deepens very greatly to dark brown. Unwin (1920, p. 416) says, "reddish," and p. 286, "greenish-brown after it has lain in the forest for a few years."

STRUCTURE.—*Transverse section*. (Prepared with glass-paper.)—See Pl. III, fig. 1.

Parenchyma of one kind: (*a*) abundant and visible to the unaided eye, sheathing the pores as broad margins, but not extending to lateral wings. Proportion of the wood about one-third (including pores).

Vessels visible as perforations, large, no apparent diminution in size, but a slight reduction in number outwards towards the ring-boundary, which is represented by a darker-coloured band: this appearance is more probably due to the smaller quantity of P. (*a*); distribution in pronounced oblique lines which change their direction from ring to ring, forming a "herring-bone" pattern; number per sq. mm. 0-7; mostly simple but many groups; widely isolated; shape, shortly oval. Contents, dark-coloured.

Rays just visible on account of their colour, very fine; of one kind only; colour *distinctly reddish*; fairly regular in size and spacing at intervals of from one to three pore-diameters; fairly straight, but slightly avoiding the pores; almost too thin to taper; proportion of the wood about one-fifth; number per mm. 8-16.

Ground-tissue-cells visible with the macroscope; to the unaided eye the ground appears dark brown; proportion of the wood about one-fifth.

Rings apparently well defined, but the true boundary is doubtful; it may be constituted by the zone of darker-coloured wood poor in pores; contour (in specimen described) is very irregular, but does not appear to be normal.

*Radial section* very brilliant and stripy, but the colour is modified by the pinkish-brown colour of the rays. Vessels contain much rich reddish-brown resin in globules and have shining linings. P. (*a*) visible with difficulty as borders to the vessels (except in the darker bands). Rays visible as prominent pinkish lines.

*Tangential section* as the radial, but the rays tend to dull and

modify the colour; they occupy about half the surface; height about eighteen cells by 2-4 rows wide, uniseriate rays being rare or absent; cells full of resin. The rays are not in parallel, but show a tendency to arrange themselves in oblique lines (in échelon).

SAPWOOD "white, narrow" (Unwin, p. 286).

BARK "resembles that of Pine" (p. 431); "inclined to scale off in small pieces, and in the distance looks practically smooth" (p. 288). "Resembles the bark of Spruce; the scales have carmine-red separation layers like those of the Larch" (Busgen ex. Harms, p. 28).

USES, ETC.—"An enormous trunk; root-spurns slight and rounded" (Unwin, p. 286); "very durable under cover; termite-proof; heartwood softens considerably in the open" (p. 286).

Density, No. 3011, 0.69, or about 43 lb. per cu. ft.

"	"	1891, 1.008	"	63	"	"
"	"	2765, 0.77	"	48	"	"
"	"	1846, 0.995	"	62 $\frac{1}{2}$	"	"
"	"	2802, 1.03	"	64 $\frac{1}{2}$	"	"

**Piptadenia africana**, Hook, f. Leguminosæ: Mimosææ.  
Gen. No. 1982.

LOCALITIES.—Everywhere in Africa from the Tropics to Delagoa Bay; Sierra Leone, Gold Coast, Liberia, Togo, Nigeria, Cameroons (British sphere), Congo.

VERNACULAR NAMES.—Abe; Agboin; Aga-iji (com. to *Cylicodiscus*); Akan; Balondo; Bolondo; Chen; Dabema; Dahomah; Dahuma; Denya (com. to *Cylico*); Ebbome; Edundu (com. to many fine-leaved Leguminous trees according to Harms, 1911, p. 22); Ehé; Ekhimi; Ekkimi; Ehimi; Ensale; Erundu; Ewon; Gbon; G'bon; Greenheart (com.); Greenheart, light African; Ikkimi; Iteruku; Jondo; K'ku-perb; Kuangua-iniama; Kuperf; Mbeli (not Mbeli-deli, see *Cylico*); Mbeliguli; Mpwere (of W. Uganda, not of Chagwe); Muneunza; Muzungo; Nainvi; Nchoumbou; Odenya (com. to *Cylico*); Odahuma; Ofrafraha; Okan (com.); Pao Musence; Redwood; Sanga; Singa; Wunga; Nchioumbou; Troum.

Description of the wood from specimens Nos. 3104 (Empire Timber Exhibition, 1920), 3267 and 3288 (from Oni) "Agboin."

Our specimen 0729 HS. from the Gold Coast, which was sent to Mr. Stone, from Kew, as being this species, is nearly allied if not the same wood, but it is much browner and darker in colour. No. 3057 "Dahuma" from the Gold Coast agrees. It is somewhat intermediate in colour between the last mentioned and the specimens from Nigeria. Other specimens Nos. 2849 HS. "Ekхими or the smaller Okan" from S. Nigeria and 2802 HS. "Denya; Odenya" from Gold Coast differ in some respects. The description given by Hopkinson (1912, p. 453 and fig. 18) accords fairly well except that none of our specimens show anything approaching to a pore-ring, nor is there any difference in the numbers of vessels between the inner and outer zones of the ring. He states that the colour is "brownish-grey."

GENERAL CHARACTERS.—A rather soft and light wood of uniform greyish-brown colour, which deepens a little on exposure. It has some resemblance to the sapwood of the English Walnut. Chevalier (1909, p. 182) says, "Colour somewhat brown."

Surface clean; cool and dry to the touch, stringy and woolly when sawn. Grain, coarse, open, comparatively straight in tangential section, but very cross-grained on a radial section. Shade of the transverse section slightly darker than that of the others. Smell recalls that of the husks of coco-nut when damp. The structure on trans. sec. is very plain. Wood very absorbent. Unwin says (1920, p. 48) that this wood resembles *Cylicodiscus* (see that species); "the heartwood is of a pretty light brown colour when dry, and appears to become softer and lighter on drying" (p. 279). Our specimens also resemble *Cylicodiscus*, or, more distantly, *Afzelia*.

*Transverse section.* (Prepared with glass-paper.)—See Pl. III, fig. 5. Parenchyma of one kind only: (a) vasicentric, visible to the unaided eye on account of its quantity and pale oatmeal colour; sheaths the pores, often extending to lateral wings, which are frequently rounded. Proportion of the wood about one-third. In the dark zones the P. (a) tends to stretch out into concentric lines and to join two or more pore-groups together, but many, if not most, of the pores are not winged.

Vessels visible as perforations; large, diminishing slightly outwards to the ring-boundary, but increasing very much in

size as the tree ages : 2-3 per sq. mm. ; arranged in prominent oblique lines, mostly inclined the same way, but occasionally reversed ; simple or in radial groups of 2-3 pores, otherwise widely isolated ; shape, oval ; contents, some dark resin.

Rays just visible here and there in the darker wood ; of one kind ; regular in size and spacing, at intervals of 2-6 times the breadth of a ray ; weak ; many thin ends, but in general tapering but little ; number per mm. 7-8. Proportion of the wood about one-sixth.

Ground-tissue-cells visible with the macroscope.

Rings apparently well defined, but the true boundary is difficult to fix ; there are light and dark zones ; contour regular.

*Radial section*.—Vessels have dark, shining linings and contain a little resin. P. (a) abundant as borders and tails to the vessels, but it lacks contrast. Rays visible as minute flecks by reflection. Rings vague.

*Tangential section* as the radial, but the rays are visible only by the matt effect that they produce, being dull, dark and very brown, giving the tone to the section ; not in parallel but nearly so (rather in échelon) ; height about 0.25 mm.

SAPWOOD.—“Slash yellow with a light brown tinge . . . sapwood white and comparatively wide” (Unwin, 1920, pp. 279, 280). “Sapwood reddish-yellow” (Harms, l.c.). “Pinkish-white with patches of a very light yellow” (Chev., l.c.). From specimen 3267 : Grey, well, but not sharply defined from the heartwood.

BARK.—“Smooth, somewhat red on the outside, carmine-red on the inside” (Harms, l.c.). “Greyish-red finely fissured” (Chev., p. 182).

USES, ETC.—“Strong canoes” (Unwin, p. 45) ; “sleepers” (p. 97) ; “durable and almost termite-proof, though the sapwood is rapidly attacked” (p. 280).

*Conservator's note*.—“A large evergreen tree plentiful in the evergreen forest. The timber is hard and does not float when green ; it is said to be durable.”

*Density*, No. 3288, 0.64, or about 40 lb. per cu. ft.

“	“	3104, 0.59	“	37	“	“
“	“	3267, 0.652	“	40½	“	“
“	“	3057, 0.75	“	46½	“	“
“	“	0729, 0.775	“	48½	“	“



Chevalier gives (1909, p. 182) 0.736 and 0.529. In the Catalogue of the Empire Timber Exhibition, 1920, it is given as 53–56 lb. per cu. ft.

*Illustration.*—Hopkinson (l.c.) fig. 18, tr. sec. x. about 50.

### **Albizzia sp.**

Leguminosæ; Mimosææ. Gen. No. 2000.

VERNACULAR NAME in Benin "Owewe." Specimen No. 4039, received from the Government of Nigeria (Benin). Unwin (1920, pp. 293–4) mentions four species having names similar to "Owewe."

GENERAL CHARACTERS.—A hard and heavy wood of a Mahogany-red colour somewhat striped light and darker. Grain, medium coarse and rather straight for a leguminous wood. Surface clean, dry and cool. Smell, strong like bad cheese.

STRUCTURE. *Transverse section.* (Prepared with glass-paper.)

Parenchyma of one kind, viz.: (a) sheathing the vessels and uniting the groups tangentially and also obliquely (i.e. it anastomoses), prominent and readily visible. The lines are very irregular in width and ragged in appearance; width about a semi-diameter of a vessel and at very variable intervals, but on an average between two to three times the same distance. Some zones are nearly free from both vessels and parenchyma. Colour of P., light pinkish-buff.

Vessels: Visible as perforations, not diminishing in size, but less in numbers in the zone above mentioned; 4–16 per sq. mm. Scattered in no particular order. Mostly pairs, but many simple and some groups of 3–4 vessels; widely isolated; oval. Proportion of the area of the section about one fifth with P. (a).

Rays: On the limit of vision, very fine and numerous; of one kind only; very regular in size and spacing at about twice their own width apart, rarely more; weak like silk threads; colour as the Parenchyma (a), but slightly deeper. Proportion of the mass about one-third. Number per sq. mm. 9–11.

Ground-tissue-cells just visible with macroscope, uniformly filled with crystals. Proportion of the mass about one-third.

Rings apparently well defined, the more or less pore-less zone may indicate the boundary.

*Radial section*.—Rays readily visible as small hoary flakes. Vessels open, mostly empty. Parenchyma (*a*) appears as borders to the vessels, obscure, visible with macroscope as excessively fine, vertical white lines.

*Tangential section* as the radial, but the rays are visible only with lens as very fine hoary lines up to twenty cells high, and not more than four wide (mostly bi-seriate). The Parenchyma (*a*) comes out more prominently in fringes and tracery.

SAPWOOD well and rather sharply defined from the heartwood; colour, dark oatmeal. The rays apparently begin to be coloured before the other elements.

Pith? Bark?

*Density*, No. 4039, 0.883, or about 55 lb. per cu. ft.

USES.—Should be useful locally for purposes needing a hard wood which works cleanly and is not coarse in the grain, but it has no special merit that would recommend it for export.

***Terminalia superba***, Engl. and Diels.

Combretaceæ. Gen. No. 2249.

LOCALITIES.—Sierra Leone, Gold Coast, Togo, British sphere Cameroons, Nigeria, Congo.

VERNACULAR NAMES.—Aaha; Afara (com. to *T. scutifera*); Affram (see note); Almond?; Bokome; Djombe; Egoyn nufwa; Kojagei; Limba; Mukonja; Mukonja, weiss; Nkom; Oaha; Offram; Olokemeji; Shingle-wood; Zimingela.

NOTE.—Egoyn or Agoyn, variously spelt and qualified, seem to be common to several *Terminalias*.

H. N. Thompson (1910, p. 19) mentions an "Affram" of the Fantis which is "near *Parinarium*." Chevalier (1909, p. 151) cites "Fram" under *T. altissima*, Chev., from the Ivory Coast, a species very near the present.

Description of the wood from specimens Nos. 3006 (Empire Timber Exhibition, 1920), 3266 (from Oni), both received from the Government of Nigeria. Our other specimens bearing native names similar to those listed above (Agoyn, Emmiri, Isa and Issieh), and another received as being *T. velutina* from

Uganda, do not agree either with the present or with the following species.

**GENERAL CHARACTERS.**—A soft, light wood of an oatmeal colour with darker striations (pores) in longitudinal section. The colour deepens little if at all. Surface distinctly dull, warm to the touch, dry, soils readily. The shade of the transverse section depends upon the satiny pile which covers the surface. Smell, none.

Unwin says (1920, p. 438), “hard, light yellow, and close-grained.”

**STRUCTURE.** *Transverse section.* (Prepared with a corundum hone and pumice-stone, but the silky pile cannot be removed by any known means.)—See Pl. IV, fig. 5.

Parenchyma of one kind : (*a*) vasicentric, easily visible to the unaided eye as sheaths around the pores by its *darker* colour (a rare feature); often joins the pores into festoons which anastomose freely; width at least equal to the long diameter of a large pore; there are about 10–12 of these lines in a wide ring and they occur in all zones; proportion of the wood about one-fifth.

Vessels visible as perforations, especially in the darker wood; large, diminishing slightly but regularly in size towards the boundary of the ring, not decreasing in numbers; 2–10 per sq. mm.; very evenly distributed; simple or in radial groups of 2–3 pores, the latter rare; widely isolated; shape, oval.

Rays just visible with the macroscope and then solely on account of their colour, which is the same as that of the P. (*a*); very fine indeed; of one kind; regular in size and spacing, about three to the pore-diam., and avoiding the pores; much resembling silk threads; 12–18 per mm.; proportion of the wood about one-fourth.

Ground-tissue-cells visible with macroscope; they recall strings of beads and probably contain crystals.

Rings very sharply defined; boundary a dark line which is the only portion of the wood where the tissue is darker than the rays, elsewhere it is much lighter; contour undulating in long waves as in the European Hornbeam (rare case).

*Radial section.*—Rather more lustrous and silky than the other sections. Grain empty. P. (*a*) visible with lens on

account of its darker colour. Rays just visible as minute flecks which in this section are rather pale; they contain resin globules. Rings *hardly traceable* in this section.

*Tangential section* as the radial, but the P. (a) is rather more evident as borders to the vessels, which are often twinned. Rays just visible on account of their darker colour; height from 8-12 cells by 1-3 wide, mostly uniseriate. "Always uniseriate" (Hopkinson, p. 454); not in parallel.

BARK.—"Ashy-grey fissured longitudinally and slightly scaly" (Comte de Briey, p. 205).

USES, ETC.—"Window-shutters, etc.; much attacked by borers" (Unwin, 1920, pp. 438, 445).

Density, No. 3266, 0.60, or about  $37\frac{1}{2}$  lb. per cu. ft.

" " 3006, 0.434 " 27 " "

Armitage gives for "Affram" 0.568, or about  $35\frac{1}{2}$  lb.

*Conservator's note*.—"A tall, very straight-growing, deciduous tree; plentiful in the mixed deciduous forest. Timber somewhat similar to the Oak in colour, with a straight grain. Floats when green. Suitable for general joinery work; used locally by the Public Works Department, for ceiling boards and wooden partitions. Soon attacked by borers."

Figures.—Hopkinson, p. 454, fig. 19, tr. sec. x. about 50.

### Terminalia sp.

LOCALITY.—Nigeria.

VERNACULAR NAMES.—Emil; Emril; Emmiri; Idigbo; other names associated with the last mentioned are: Yellow Terminalia; Blackbark Terminalia; Opepe and Epepe (both com. to *Sarcocephalus*); Egoyn nebbi; Egoyn nikwi; Egoyn lukan.

Description of the wood from a specimen No. 3005 "Idigbo," received from the Government of Nigeria (Empire Timber Exhibition, 1920). It agrees in all important details with the foregoing species.

STRUCTURE.—As in *T. superba*, with exception of the following details.

GENERAL CHARACTERS.—Colour, yellow, deepening distinctly on exposure. Grain, rather inclined. Weight heavier. Smell recalling that of the Californian Poppy, fragrant.

*Transverse section*.—See Pl. IV, fig. 6.

Parenchyma (*a*) of a lighter colour; joins the pores into oblique lines rather than into festoons, and very few are really joined; colour lighter than that of the rays, nearly white.

Vessels visible as perforations; a marked tendency to oblique lines; 4-6 per sq. mm.

Rays visible with the lens, and even just with the unaided eye on account of their large size; intervals equal to about three times the breadth of a ray; they suggest silky threads; number per mm. 8-10.

Rings well defined; boundary a dark line or band; the whole of the ground is darker than the rays. The contour is undulating precisely as in *T. superba* (see that species), which seems to confirm this feature as a character. No resin globules except in apparently traumatic tissue.

*Density*, No. 3005, 0.504, or about 31½ lb. per cu. ft.

### **Casearia sp.**

Flacourtiaceæ. Gen. No. 2543.

**LOCALITIES.**—Nigeria. As to the genus—from the Tropics to Delagoa Bay (Thonner, p. 372).

As no precise species is mentioned, other details cannot be given. The only *Casearia* mentioned by Unwin (1920, p. 230) is the "Ebo" of the Yorubas. Thonner, however, says that there are twenty African species.

Description of the wood from a specimen No. 3013, without native name, sent by the Government of Nigeria (Empire Timber Exhibition, 1920).

**GENERAL CHARACTERS.**—A moderately hard and heavy wood of a nut-brown colour with darker bands relieved by lighter striæ. It somewhat resembles Teak. Surface clean, dry, not cold to the touch. Grain, coarse, open, fairly straight. Shade of the transverse section perhaps a little lighter than that of the others on account of the pale soft-tissue (parenchyma). Smell rather unpleasant when wetted, recalling that of fuller's-earth. Not likely to soil.

**STRUCTURE.** *Transverse section.* (Prepared with glass-paper.)—See Pl. III, fig. 6.

Parenchyma of two kinds: (*a*) vasicentric and (*b*) concentric (see further). Parenchyma (*a*) visible to the unaided eye as narrow sheaths around the pores, but not joining them (except

in the m-and-d groups); colour, light brown. Proportion of the wood, small.

Parenchyma (*b*) only just visible with lens as regards the individual lines, but their abundance makes them visible in the mass very readily. It is arranged in concentric, much interrupted lines, or rather in bars irregularly inclined between the rays; number of lines per (radial) mm. very variable, 9–15 where present, otherwise at intervals equal to a little more or less than the spaces between the rays and fairly regular except in the dark wood, where they are for the most part invisible. They recall the P. (*b*) bars of the European Walnut. Proportion of the wood about one-sixth. Very absorbent, swelling much on moistening. Contents granular.

Vessels just visible as perforations, size medium scarcely diminishing in size or numbers outwards; evenly distributed; 9–14 per sq. mm. Simple or in groups of 2–5; (simple pores few); widely isolated; oval; proportion of the wood, about one-quarter (including P. (*a*)).

Rays visible with difficulty; of one kind and very fine; colour as the P. (*b*), i.e. buff; fairly regular in size and spacing, at intervals of about three times their own width; number per mm. 15–16; weak; some thin ends, indeed, the rays seem to become thinner in the dense wood. Contents dark and granular. Proportion of the wood, about one-third.

Ground-tissue-cells just visible with macroscope; contents, small granules. Rings apparently defined to the unaided eye, but less so with lens; contour regular.

*Radial section*.—Parenchyma (*b*) visible with the macroscope with attention, as fine lines. P. (*a*) visible with lens. Rays visible by reflection, with the unaided eye. The rays are perhaps slightly lighter in colour than the ground and contain much resin, chiefly of a reddish-brown colour.

*Tangential section* as the radial, but the rays are minute lines about twenty-five cells in height by 2–3 rows wide containing many black granules. Not in parallel.

*Density*, No. 3013, 0.826, or about 51½ lb. per cu. ft.

**Sarcocephalus esculentus**, Afzel. Rubiaceæ. Gen. No. 3000.

*Synonym*.—*S. sambucinus*, K. Schum. (see note to next species).

LOCALITIES.—Sierra Leone, Gold Coast, Liberia, Ivory Coast, Togo, Cameroons, Congo, French Central Africa, Senegal.

VERNACULAR NAMES.—Adesekanchie; Agbassy; Agbesi; Ameliki; Amelliky (com.); Awesu; Awessu; Badi; Baya (com. to *Mitragyne*); Doy; Dundaka; Dundake; Eben; Egbesi; Egbesaye; Ekusawa; Essoubo; Fig; Fig, country; Fig, African; Golli; Jadali; Kina du Rio-nunez; Kishia; Kisia; Kusia; Kusiaba; Kussiabah; Lignum Djimo; Nonble; Obiache; Onhôn; Okusia; Opepe (see note below); Owessu; Owussu; Peach; Peach, African; Peach, negro; Peach, Sierra Leone; Peach-root; Quinine, African; Quinquina africain; Sibô; Tafasiya; Tétére; Weather-board wood; Woacroolie; Wuacruli; Viku; Yellow-fever-root; Bilinga (com.); Pan de frute.

NOTE.—The name "Opepe" variously spelt is common to the other species of this genus, to *Terminalia*, *Pterocarpus*, *Mitragyne*, and perhaps *Mimusops*. Chevalier, writing of "Viku," says that a wood of little value is exported from the Congo under this name.

Description of the wood from specimens Nos. 3284 (from Oni), 3000 "Kusiaba" (Empire Timber Exhibition, 1920) and 3015 (from same source) "Opepe." Our specimens Nos. 2809 HS. "Kusia; Ekusawa" from the Gold Coast, 1905 HS. "African Teak," 2008 HS., 0751 HS. from commercial sources, all agree. The specimen of Swamp Opepe, No. 3818 from Benin received from the Government of Nigeria, is an entirely different wood and is described hereafter.

GENERAL CHARACTERS.—A moderately hard and heavy wood of a uniform brownish-yellow colour which is characteristic. Surface clean, hardly cold to the touch, not likely to soil. The colour does not deepen much on exposure. Grain, very cross, coarse and open. Smell, none.

STRUCTURE. *Transverse section*. (Prepared with broken glass.)—See Pl. IV, fig. 1.

Parenchyma of one kind: (a) vasicentric, visible to the unaided eye, lighter in colour than the rays; sheaths the pores and sometimes (in wide rings) connects the pores into oblique lines. Proportion of the mass, including vessels, about one-third. In some specimens reputed to be of this

species, the parenchyma has been very difficult to find, being absent, or exceedingly obscure.

Vessels easily visible to the unaided eye as perforations, very prominent, not much diminution in size, but a little decrease in numbers towards the outer limit of the ring; widely isolated; a strong tendency to oblique lines and angles; few, 4-6 per sq. mm. Simple for the most part, few if any m-and-d pores; shape, strongly oval; proportion of the wood relatively small; tyloses abundant; contents, occasional red globules.

Rays visible with lens, very fine; of one kind; lighter in shade than the ground; regular in spacing, about 2-3 to the pore-diam.; straight; tapering but little; number per mm. 15-18.

Ground-tissue-cells not visible with the macroscope, harsh and horny, causing wood to be short and brittle.

Rings ill defined; boundary a zone of denser wood; contour regular.

*Radial section.*—Grain, coarse, very much inclined, changing in direction ring by ring. P. (a) visible with lens; contains numerous crystals. Vessels, coarse open grooves with gummy, lustrous linings and many globules of red resin, also tyloses. Rays visible with lens, light in colour, dull. Rings not traceable.

*Tangential section* as the radial, but the Parenchyma is doubtfully traceable. Rays visible with lens as fine, slightly lighter lines; height about 12-15 cells; not in parallel; chiefly uniseriate.

SAPWOOD.—“Slash yellowish-white and rather dirty colour. A mucilage-like latex exudes from the cut; there is only a slight difference between sap and heartwood” (Unwin, p. 402). “Sap and heartwood not differentiated” (Chevalier, 1909, p. 230). Some of our specimens have a clearly defined sapwood which is much darker than the heartwood.

BARK.—“Slightly rough and scaly, but in an even manner” (Unwin, p. 402, l.c.); “Bark grey, deeply fissured, scaling in large plates” (Chev., p. 231).

USES, ETC.—“Inlaying” (Unwin, p. 79); “very durable indeed, termite-proof both in exposed places and for interior work; sapwood not quite so durable; canoes, bridge-building” (p. 403).



<i>Density</i> , No. 3000, 0.775, or about 48½ lb. per cu. ft.				
„ „ 3015, 0.768	„	48	„	„
„ „ 2809, 0.787	„	49½	„	„
„ „ 1905, 0.753	„	47	„	„
„ „ 2008, 0.751	„	47	„	„
„ „ 3284, 0.872	„	54½	„	„

Chevalier gives 0.676, or about 42½ lb. per cu. ft., but he states that the tree is a small one of 5–7 metres in height by 0.15 to 0.20 m. diam., whereas our specimens indicate large trees.

*Conservator's note.*—"A large evergreen tree of the evergreen forests. Much used by the natives for canoes and planks, on which account large trees are becoming scarce. Used by the Public Works Department for flooring boards and general joinery when they can obtain supplies. The timber is of a golden yellow colour, easily worked and durable."

### Swamp Opepe.

Rubiaceæ. Gen. No. 3000.

Is this *Sarcocephalus sambucinus*? Unwin (1920, p. 404) regards this as a different species, and says that the bark is less scaly with very slight roughness or fissured surface; wood not so durable as that of the preceding species, and doubtfully termite-proof.

Description from a specimen, No. 3018, received from the Government of Nigeria (Lagos) and listed as *S. esculentus*, but marked "Swamp Opepe."

VERNACULAR NAMES associated with *S. sambucinus*.—Akuto-basa; Eben; Ebengiku; Kedjedjelo; Nyimo; Obiache; Opepe; Opepe, swamp; Tabu; Yellow-wood.

Our specimen No. 2814 HS. "Affna; Affna sappa," from the Gold Coast, is very near the present species.

GENERAL CHARACTERS.—A hard and heavy wood of a bright yellow colour, a little stripy, but otherwise uniform, much resembling the common Opepe, but much finer in the grain. Surface clean, dry, not cold to the touch. Cross-grained and rips out during planing. Shade of transverse section when cleaned much darker than that of the other sections, but on a rough saw-cut light citron colour. Smell, none.

STRUCTURE.—Resembles that of many Rutaceous woods,

but is entirely different from that of the common Opepe (*Sarcocephalus esculentus*).

*Transverse section.* (Prepared with glass-paper.)

Parenchyma of three kinds: (a) narrowly sheathing the vessels, very pale yellow in colour; (b) in excessively fine bars from ray to ray and if anything finer, at intervals about equal to the space between the rays, practically absent from the denser zones, colour nearly the same as the rays; (c) terminal, simulating the boundaries of the rings, but only occasionally visible and readily overlooked on account of lack of contrast; a very narrow line a little finer than the rays.

Vessels just visible as perforations (on clean-cut section), small, diminishing slightly towards the outer edge of the ring, uniformly distributed except in the dense zones where there are few if any, scattered in no particular order; number per sq. mm. 16-27. There is a tendency for the vessels to run into straggling lines in various directions; mostly single, some groups of 2-3. Shape, broadly oval. Contents, white masses. Proportion of the area of the section (including their parenchyma) not more than one-sixth.

Rays visible with lens, very fine, of one kind, fairly regular in size and spacing at intervals of rarely more than twice their own width, very numerous; proportion of the mass of the woods at least one-third: number per mm. 14-18.

Ground-tissue-cells visible with the macroscope, their contents (crystals?) showing as white points; proportion of the mass about one-third.

Rings apparently well defined, but no definite boundary unless indicated by the dense zones or the line of parenchyma (c).

*Radial section.*—Rays just visible by reflection as fine lines. Parenchyma (a) readily visible as very fine borders and tails to the vessels; P. (c) rarely appears. Vessels, very fine grooves just visible, except where their white contents make them more prominent. Besides the white contents there are some reddish-brown globules here and there.

*Tangential section* as the radial, but the vessels seem rather more prominent on account of cross-grain. Rays very minute and obscure spindle-shaped lines visible with the macroscope, up to sixteen cells high and 1-3 wide; not in parallel. With a high power many brown globules are to be seen.

*Density*, No. 3618, 0.74, or about 46 lb. per cu. ft., but it is partly sapwood. Sapwood only works out at 0.69.

*PITH*.—Hoary, about 8 mm. wide (at the node); contains many minute amber beads.

*SAPWOOD*.—Light citron-yellow; well defined; much darker in transverse section. Very wide.

*BARK*.—Greyish-brown, very fibrous with shallow, vertical fissures with a tendency to break up into scales; thickness of specimen, about 4 mm.; much stringy bast, which is fairly strong. Fracture of bark, fibrous; scleroses small, rare, in the outer zone of the bark.

*USES, ETC.*—The heartwood is of a beautiful colour and very close-grained and compact. If it could be seasoned without cracking it would make an excellent turners' wood and could be utilized for many purposes for which boxwood is employed.

***Adina microcephala***, Hiern. Rubiaceæ. Gen. No. 3004.

*Synonym*.—Gilg (p. 131) cites *A. microcephala* (Leprieur et Guill), K. Schum, from the Cameroons, and states that the wood is whitish-yellow. Is this a different species?

*LOCALITIES*.—Togo, Nile-land, Nigeria, French Central Africa, Portuguese East Africa.

*VERNACULAR NAMES*.—Bara; Hadenya rafi; Kadanyar kurumi; Kadanyar rafi; Muhambo (for var. *Galpini*); Mwenya; Mahonhe; Mshlume; Mugonha; Mugunya; Pao d'oleo; Pau de oleo.

Description of the wood from a specimen No. 3010 "Kadenya rafi" (Empire Timber Exhibition, 1920) received from the Government of Nigeria. Our specimen No. 2906 HS. "Nikiba; Osikiba" from S. Nigeria and No. 3337 "Mwenya," from Nyasaland agree in all essential details. Nos. 2814 HS. "Affna sappa; Affna" from the Gold Coast and 2916 "Sarutu" from the Ivory Coast are near, the former connecting the Swamp Opepe with this species, indeed Swamp Opepe more closely resembles *Adina* than it does *Sarcocephalus*.

*GENERAL CHARACTERS*.—A rather hard and heavy wood of a yellowish-brown colour with darker stripes and flakes. Colour deepens considerably on exposure. Surface dull, rather cold to the touch and a little clinging ("oily feeling" Unwin, 1920, p. 145; also Volkens, 1901, p. 26). Very fine and cross-

grained. Shade of transverse section nearly similar to that of the other sections. Would soil on account of the stickiness of the surface. Smell, faint, but when wetted rather unpleasant, recalling Elm. "Characteristic smell" (Volkens, l.c.).

STRUCTURE.—Distinctly resembles that of most Rutaceous woods.

*Transverse section.* (Prepared with broken glass.)

Parenchyma of one kind only : (a) very narrowly sheathing the pores and just visible from its colour as white points.

Vessels not visible except by means of the P. (a), very small, uniform in size, but diminishing in number outwards to the ring-boundary, where they thin out considerably, becoming widely isolated and leaving many empty spaces, 36–40 per sq. mm. in the inner zone of the ring, 20–35 per sq. mm. in the outer zone. Apparently all simple (i.e. no groups of pores); shape, oval; contents, red or sherry-coloured. Proportion of the wood, very small.

Rays just visible in the darker bands; of one kind only; very evenly spaced; slight variation in size, but with many thin ends. There are about two to the tangential diameter of a pore. Fairly straight, but with considerable amount of taper; 15–26 per mm.; proportion of the wood about one-third.

Ground-tissue dense; cells just visible with macroscope, more on account of certain points which appear to indicate crystals; colour a beautiful golden-brown; proportion of the wood about one-half.

Rings ill-defined to the unaided eye and still less definite when magnified, no certain boundary; some dusky bands of pigment here and there.

*Radial section.*—Parenchyma (a) just visible with lens. Vessels just visible to the naked eye as fine scratches; contents, white, opaque and amorphous, along with some globules of a sherry-colour.

Rays visible as very small flakes, by contrast of colour, being darker than the ground.

*Tangential section* as the radial, but the rays are minute lines just visible with lens; not in parallel; height up to about nineteen cells by one cell wide for the most part; contents abundant, the rays being filled with resin or gum, as indeed

is the whole of the tissue, which accounts for the slight stickiness of the surface. Strings of white beads (crystals) come out clearly in this section.

*Density*, No. 3010, 0.997, or about 62 lb. per cu. ft.

„ „ 3337, 0.89, „ 55½ „ „

**Mitragyne macrophylla**, Hiern. Rubiaceæ.

Gen. No. 3005.

*Synonym*.—*Mamboga stipulosa*, Welw.

*LOCALITIES*.—Gold Coast, Ivory Coast, Togo, Nigeria, Congo, Nile-land.

*VERNACULAR NAMES*.—Abura; Atchipon; Apuro; Bahia (com. to *Sarcocephalus*); Bois de Bahia; Baya; Bodo; Bulokossa; Burokossa; Ebar; Elélom; Elélou; Fofu; Gofa; Kobodigansu; Mboi; Mungo; M'vuku maza; Ntowo; Ogouwa; Opepe, false; Osikiba; Sefono; Sofo; Soufo; Tilleul d'afrique; Togba; Ubuen; Ugbodokossa; Ya-ya; Yahyah; Yar-yah; Yaya; Yowi; Yuku; Oganedjo; Elelommzame; Ossoupou.

Description of the wood from specimens Nos. 3016 (Empire Timber Exhibition, 1920), 3286 (from Oni), 3611 (from Lagos) and 4040 (from Benin) all "Abura," received from the Government of Nigeria. Our specimens Nos. 2841 HS. "Supuwa; Osupuwa" 3088 HS. "Mboi" from the Gold Coast, and 3798 "Nturgo" from a commercial source, all agree, but No. 2842 HS. "Yaryah" from the G.C. and other specimens of "Apuro" from the same Colony, do not.

*GENERAL CHARACTERS*.—A wood of medium weight and hardness and of a warm brown colour splashed with darker patches caused by cross-grain. These patches form a rough zigzag tracery here and there. The wood resembles that of the European Pear-tree. Chevalier (1909, p. 228) says, "colour light yellow tinged with pink." Surface dull. Would soil readily; rather warm and velvety to the touch. Grain, medium coarse and open. Shade of the transverse section very slightly darker than that of the other sections. Smell, faint, perhaps a little spicy.

*STRUCTURE*.—Very characteristic and unusual.

*Transverse section*. (Prepared with pumice-stone; very troublesome.)

Parenchyma of two kinds : (a) vasicentric and (b) in fine bars, concentric.

Parenchyma (a) visible to the unaided eye, narrowly sheathing the pores uniting them into radial lines ; lighter in colour than either the rays or the P. (b).

P. (b) in concentrically arranged bars at right angles from ray to ray, but apparently never passing across a ray. They cut off rectangular areas of the ground tissue, simulating the cells of a ray highly magnified. Colour brown, about the same as that of the rays ; contents, much resin. Number per radial mm. 10-13.

Vessels visible only from the P. (a) surrounding them, but by this aid they appear as long fine radial strings ; size small, diminishing little if at all outwards ; evenly distributed ; simple at times, but mostly in radial groups connected by P. (a) and also m-and-d groups, which are sometimes difficult to distinguish from the former ; some twinned groups ; isolated but not widely, being very numerous, about 30-36 per sq. mm. ; shape, oval ; contents, some resin and perhaps tyloses. Proportion of the wood including P. (a) about one-third.

Rays not very small and would be visible to the unaided eye (at least when wet) were it not that they are masked by the radial lines of pores ; doubtfully of two kinds, but there are occasional large rays which are readily visible and which suggest aggregation. Colour, brown ; spacing fairly regular and size also, except as regards the large ones just referred to. Very numerous and closely set, at intervals of about 2-3 times their own breadth. 12-15 per mm. Contents, some resin ; proportion of the wood about one-quarter.

Ground-tissue-cells visible with the macroscope ; colour, deep, dull amber ; proportion of the wood not more than one-quarter.

Rings vaguely defined to the unaided eye and less so with lens ; boundary apparently a vague zone of denser tissue ; contour regular.

*Radial section.*—P. (a) not visible even with the macroscope ; P. (b) with the same magnification appears as excessively fine lines containing resin. Vessels readily visible ; very tortuous ; linings shining ; contents, some dark-coloured globules. Rays very small, visible by reflection, but only where the grain is

straight. The grain is so twisted that sometimes the transverse section comes out on the radial surface where even the P. (b) can be seen as in trans. section. A feather pattern discernible here and there.

*Tangential section* as the radial, but the grain if anything is even more tortuous. Rays very numerous and close, sometimes split up by fibres being drawn across them; not in parallel; height variable, up to twenty cells high by 1-4 rows wide.

SAPWOOD not defined from the heartwood. Pith? Bark?

*Density*, No. 3016, 0.51, or about 32 lb. per cu. ft.

„	„	3286, 0.49	„	30½	„	„
„	„	3611, 0.57	„	35½	„	„
„	„	3088, 0.69	„	43	„	„
„	„	2841, 0.55	„	34½	„	„
„	„	4040, 0.62	„	38½	„	„
„	„	2906, 0.554	„	34½	„	„

Figures from other authors are: Chevalier, 0.559-0.574 (1909, l.c.) and 0.619 (1917, p. 22); Holland, 0.536; Armitage, 0.54.

**BARK.**—Chevalier (1909, p. 228) says, “whitish fissured longitudinally, very thick, scaling in plates,” and again (1917, p. 223), “ashen, strongly adherent to the sapwood, very thick (12-15 mm. about), falling away in quite small scales; red-orange in section.”

**USES, ETC.**—“For doors, drums and barrels” (Unwin, 1920, p. 145).

*Conservator's note.*—“A fairly large straight-growing evergreen tree, practically confined to the neighbourhood of fresh-water swamps, where it grows in groups. Large trees are not plentiful. The timber, which floats, is of a reddish colour. A good general purpose wood, largely used by the Public Works Department for flooring boards.”

***Alstonia congensis*, Engler.**

Apocynaceæ. Gen. No. 4609.

*Synonym.*—*A. scholaris*, Chevalier (not R. Brown).

**LOCALITIES.**—Sierra Leone, Gold Coast, Togo, Ivory Coast, British sphere of the Cameroons, British East Africa, Nigeria, Senegal, Uganda, Sudan, Nile-land.

VERNACULAR NAMES.—Abo; Ahon; Ahun; Awun; Baku nin; Bantang foro; Bokuk; Bokuka; Bokuka-ba-mhale; Dubu; Eba; Ebu; Eckou; Ekuri; Emien; Etiap; Hon-guié; Idu; Kanja; Kauwi; Kokué; Kuge; Leroi; Lerué; Lorué; Niamidua; Nimeribaka; Nya-me dua; Ofemm; Ogudugbu; Oguk; Pattern-wood; Sindra; Sindru; Sindura; Stool-wood; Uhu; Ukhu; Ukpu; Whitewood; Wokuka.

Description of the wood from specimens Nos. 3007 (Empire Timber Exhibition, 1920), 3298 (from Oni) and 3621 (from Lagos), all "Awun," received from the Government of Nigeria. Our specimen 2829 HS. "Sindru," from the Gold Coast, agrees.

GENERAL CHARACTERS.—A comparatively soft and light wood of a quite uniform pale oatmeal colour which deepens but little on exposure. Surface clean, but likely to soil; warm to the touch. Grain, medium, open and straight. Shade of the transverse section little if at all different from that of the other sections. Smell, faint, slightly recalling fuller's-earth. The wood resembles that of the European white-wooded Poplars.

STRUCTURE, *Transverse section*. (Prepared with pumice-stone.)

Parenchyma of apparently two kinds: (a) vasicentric and another kind of uncertain nature.

Parenchyma (a) sheaths the vessels rather narrowly, visible? colour, inclining to oatmeal, very light. Hopkinson says (1912, p. 445) only metatracheal parenchyma, i.e. the following:—

Parenchyma (b) in fine, nearly continuous, concentric lines which touch the pore-groups in as many as three places. Width of the lines equal to about that of the rays; intervals rather more than that between the rays; evenly distributed throughout the ring, but more readily visible in the hard wood near the boundary.

Vessels visible by means of the P. (a) surrounding them, medium in size, diminishing little if at all in size or number. Somewhat evenly distributed, but there is a slight tendency to oblique lines. Simple, or in very characteristic groups of 2–10 pores, otherwise widely isolated. Shape, roundish. Proportion of the wood, not much more than one-eighth. Number per sq. mm. 1–11.

Rays visible at arm's length; of one kind only; colour



brownish, slightly darker than the ground. The rays either split up or are inclined to unite in brush-like tufts (aggregation ?); they are otherwise very close here and there, being very irregularly spaced, and also irregular in size. Weak; many thin ends; number per mm. 9–12; proportion of the wood rather more than one-quarter.

Ground-tissue-cells visible with the macroscope; they apparently contain crystals.

Rings in appearance well defined by a line of contrast in colour; contour regular except where there is a brush of rays and then a notch appears as in the European Alder, etc.

*Radial section*.—P. (a) visible on account of its abundance. The Parenchyma of the second kind appears as fine lines (macroscope). Vessels empty with brownish linings. Rays visible as narrow lustrous brownish flakes. Rings not traceable.

*Tangential section* as the radial, but the rays are just visible as very fine brown lines not in parallel; height twelve to fourteen cells; Hopkinson says, three to eleven cells by one to three rows wide. They occasionally collect to form browner groups.

NOTE.—When the tertiary thickening of the vessels is removed certain muriform bodies are seen. These may be very large pits or anomalous tyloses, and need further investigation.

SAPWOOD.—“ Little difference between sapwood and heartwood. Slash white with yellow spots; a chalky latex exudes when it is cut, rapidly running down the stem like a streak of whitewash ” (Unwin, p. 390).

BARK.—“ The white lenticels are very typical of the tree and give it the appearance of having a rust-disease ” (ibid., l.c.). Chevalier (1909, p. 121) says, “ Bark ashy-grey, scaly, exuding an abundant white latex when cut. This coagulates, forming a resinous material which rapidly hardens.”

USES, ETC.—“ Is attacked by termites; not durable in the open ” (Unwin, l.c.).

*Density*, No. 3007, 0.39, or about 24 lb. per cu. ft.

“ „ 2829, 0.329 „ 20½ „ „

“ „ 3289, 0.38 „ 24 „ „

“ „ 3621, 0.382 „ 24 „ „

Chevalier (l.c.) gives 0.391.

*Conservator's note*.—“ A fairly large tree, plentiful in the

evergreen forests, especially in the neighbourhood of fresh-water swamps, also found in the deciduous forests near swamps."

*Illustrations.*—Hopkinson 1912, p. 446, fig. 5, tr. sec. x. about 50. Fig. 6, parenchyma with crystals. Fig. 7, wood-fibres tr. sec. showing pits.

**Uapaca Staudtii**, Pax. Euphorbiaceæ. Gen. No. 6428.

LOCALITIES.—Nigeria, British sphere Cameroons.

VERNACULAR NAMES.—Akun; Bosambe; Bosambi (com. to *Pycnanthus*; not Bosambai).

Description from a specimen No. 3610 "Akun" Nigeria, received from the Government of the Colony (Lagos).

A moderately hard and heavy wood of a colour rather darker than that of English Beech, but distinctly recalling that wood. Dark stripes here and there; grain, medium coarse; surface clean; dry to the touch, not cold; shade of the transverse section considerably darker than that of the other sections; smell, none; polishes readily. The red rays are an unusual character; silver-grain very prominent.

STRUCTURE. *Transverse section.* (Prepared with glass-paper and broken glass.)

Parenchyma of one kind only: (a) sheathing the pores and making them readily visible to the naked eye; not extending in wings; colour, buff; proportion of the mass of the wood, including vessels, about one-third.

Vessels just visible to the unaided eye as perforations apart from their parenchyma, rather large, not diminishing outwards in size. Variation in numbers considerable by zones at indefinite intervals; number per sq. mm. 8–16. Arrangement as a rule regular, being scattered evenly over the section, but here and there where the vessels are less numerous there is a suggestion of oblique lines, otherwise the vessels are widely isolated; mostly single, but many pairs; oval; empty.

Rays on the limit of vision not contrasting much with the ground except here and there where darker ones occur; red; of one kind only; about the size of those of the English Birch; straight; number per mm. 5–7; about the width of a vessel apart, very regular in size and spacing; proportion of the mass of the wood about one-third. Contents, red.

Ground-tissue-cells visible with macroscope. Proportion of

the mass about one-third. Contents crystalline or granular.

Rings not traceable at all, but zones of varying density are visible to the naked eye; contour regular.

*Radial section*.—Grain, open, the vessels having shining linings, with granules and red resin globules. Parenchyma (*a*) appears as hoary borders and tails to the pores. Rays very conspicuous like those of Beech, of a dark, rich brown, but dull.

*Tangential section* as the radial, but the rays are obscure, small, dark-coloured, spindle-shaped lines up to  $\frac{1}{4}$  inch high; multiseriate, not in palissade.

Pith? Sapwood scarcely defined from the heartwood.

**BARK**.—Exterior rough, but not fissured, covered with light-coloured excrescences. Colour, white over brown; subjacent layers chocolate-brown throughout. Lenticels not traceable. Texture harsh, fracture granular; smell, none; adhesion to trunk moderately strong.

Section of bark: Thickness about  $\frac{1}{2}$  inch; homogeneous; colour, chocolate; scleroses prominent. Inner surface straight in the grain; brown; shows the impressions of the rays.

*Density*, No. 3610, 0.76, or about 47 $\frac{1}{2}$  lb. per cu. ft.

***Ricinodendron africanus*, Muell. Arg.**

Euphorbiaceæ. Gen. No. 6465.

**LOCALITIES**.—Sierra Leone, Gold Coast, Ivory Coast, Togo, Cameroons, Nigeria, Gaboon, Uganda, Congo, Nile-land.

**VERNACULAR NAMES**.—Asama; Asoma; Assomah; Awama; Boi-feko; Bofeko; Ehan; Ekku (not Ekki, see *Lophira*); Engessang; Engessan; Erimado; Erimmado; Esango; Essang; Funfun; Gbolei; Haipi; Hobo; Hapi; Hoho; Isain; Issanguila; Mougongome; Munguella; Nbob; Njangsang; Nsa-sana; Ochwen, Okkwen, Okwen (com. to *R. Rautenii*, *R. Heudelottii* and *Brachystegia*); Okro Koods; Okwenseva (com. to *R. Rautenii*); Owama; Owema; Ozaneguila; Poposi; Puttuputtu (com. to *R. Rautenii*); Sanga Sanga; Sosau; Tsain; Wonjangasanga; Wongasanga; Wood-oil-nut-tree.

Description of the wood from a specimen No. 3004 sent by the Government of Nigeria. Our specimen No. 2990 HS. from Uganda, authenticated by Mr. Dawe, agrees.

**GENERAL CHARACTERS.**—A very light, soft wood of a dirty white colour which deepens little if at all on exposure. It may easily be mistaken for the wood of *Eriodendron*, p. 17, of this series. Surface dull and floury, warm to the touch, very easily soiled. Grain, very coarse and open, fairly straight. Smell of musty nuts, as observed in other species of the same family. Wood exceedingly absorbent.

**STRUCTURE.**—Very characteristic.

*Transverse section.* (Prepared with limited success by all known methods in turn. Description from a surface rubbed down with pumice-stone, controlled by section with a razor.)

Parenchyma of one kind: (a) obscure and scanty, in contact with the vessels.

Vessels readily visible as perforations, very large, apparently diminishing somewhat in size, but not much in number, towards the outer limit of the ring; 0-3 per sq. mm.; very widely isolated; many empty spaces exceeding  $1\frac{1}{2}$  sq. mm. in area; distribution indefinite, but a slight tendency to oblique lines; simple and in radial and nested groups of 2-5 pores; shape, oval; contents, very large tyloses; proportion of the wood, very small, not more than one-twentieth.

Rays very fine; of one kind only; colour slightly lighter than that of the ground; regular in size, but less so in spacing, as many as four to the pore-diam.; 12-15 per mm.; extraordinarily numerous, occupying nearly half the mass of the wood, hence, from their abundance and close proximity, have sometimes the appearance (to the naked eye) of large or aggregate rays.

Ground-tissue-cells just visible with the *lens*.

Rings not prominent but apparently well defined; contour regular.

*Radial section.*—Vessels very large, but owing to lack of colour are invisible in certain lights; often filled with white tyloses and a very small amount of resin. Parenchyma obscure. Rays visible by reflection only; the ray-cells are smaller than those of the ground-tissue (rare case).

*Tangential section* as the radial, but the rays appear as minute spindle-shaped bodies of a pale brown colour which furnishes almost the only colouring matter in the wood; not in parallel.

**BARK.**—"The upper part of the trunk is of a bright, herbaceous green, smooth; deeply furrowed" (Welwitsch, II, p. 971). Chevalier (1909, p. 161) says, "Dark greyish, scaling in thick plates like that of the Oak," and again (1917, p. 299), "Brown, much wrinkled; 6-8 mm. thick; spongy within and forming a thin rhytidome which readily scales off."

*Density*, No. 3004, 0.282, or about  $17\frac{1}{2}$  lb. per cu. ft.

" " 2990, 0.29 " 18 " "

Chevalier (l.c.) gives 0.346, 0.318 and 0.327, and again (1917, p. 299) 0.258, adding that when the wood is quite dry the density falls to 0.200.

**USES, ETC.**—"For tamtams, very sonorous" (De Wildeman, II, p. 971). A timber of very doubtful value, in any country or situation.

### **Excœcaria sp.**

Euphorbiaceæ. Gen. No. 6571.

Specimen No. 3616 "Orupa" received from the Government of Nigeria (Lagos).

A moderately hard and heavy wood of a very unusual yellowish colour (at times brownish or orange), much resembling the "Opepe" (*Sarcocephalus*), for which it can easily be mistaken. Colour almost uniform except for a little stripe. Surface clean, dry and somewhat cold to the touch. Grain, medium, fairly straight. Shade of the transverse section slightly darker than that of the other sections (orange when roughly sawn).

**STRUCTURE.** *Transverse section.* (Prepared with glass-paper.)

Parenchyma apparently of one kind, viz.: (a) narrowly sheathing the pores and light yellow in colour.

Vessels visible by means of their parenchyma and just visible as perforations, small, almost uniform in size; number per sq. mm. 7-12. Arrangement indefinite, being distributed more or less regularly over the whole section, widely isolated; mostly single, a few pairs. Shape, roundish; mostly empty, but a few globules of resin here and there. Proportion of the wood, including the sheaths of parenchyma, about one-sixth.

Rays on the limit of vision, very fine, of one kind only, very numerous and uniform in size and spacing, being at intervals

of about 1-2 times their own width ; colour, yellowish-brown, rather darker than the P. (a). Straight ; number per mm. 10-18. Contents, some red resin. Proportion of the mass at least one-third.

Ground-tissue-cells visible with the macroscope ; proportion of the wood about one-half.

Rings very vague, the darker zones may indicate the boundaries.

*Radial section* slightly mottled by the silver-grain which covers about half the surface and is more or less visible according to the incidence of the light, being quite dark in one light and almost invisible in another. Grain, open, with characteristic red globules here and there. Parenchyma (a) visible as hoary borders and tails (less so with lens). The cells of the wood-fibres are clearly visible with the macroscope, as are also those of the rays ; the former are in parallel. The resin in the ray-cells sometimes forms continuous lines resembling the resin-parenchyma of conifers.

*Tangential section* as the radial, but the rays are minute vertical lines from one to two or even three cells-wide, and up to thirty high. The red resin appears as fine points in both rays and vessels, and even with the naked eye the globules appear as glistening points in a brilliant light.

Pith ? Sapwood ? Bark "Smooth, yellowish" (Unwin, 1920, p. 336).

*Density*, 0.90, or about 56 lb. per cu. ft.

***Chlorophora excelsa*, Bentham and Hooker.**

Moraceæ. Gen. No. 6609.

LOCALITIES.—From the Gold Coast to Tanganyika Territory, Nigeria, Uganda, Sierra Leone, Gold Coast, Ivory Coast, Liberia, Cameroons (British sphere), Upper Guinea, Angola, Togo, Nile-land, Congo.

VERNACULAR NAMES.—Abwang ; Agui ; Aguil ; Akédé ; Alui ; Amoreira (com.) ; Bang ; Bakana ; Beket ; Bonzo ; Camba Camba ; Cokewood ; Corkwood (Unwin, p. 83, but apparently a slip) ; Edoum ; Efryio ; Elm ; Elm, rock ; Elui ; Emang ; Guele ; Guenlé ; Iroko ; Kambala ; Logo asagu ; Loko ; Mangi ; Mbang ; M'bundu ; Mbundu ; Mokonongo ; Moreira ; Mucamba-camba ; Momangi ; Muamba-

camba ; Muti ; Muvule ; N'san ; N'tong ; Oak, African (com.) ; Oak, bush ; Obang ; Oba's-tree ; Odji ; Odom ; Odoum ; Odum ; Ofryio ; Oloko ; Oroko ; Roko and Rokko ; Semee ; Ssäre and Sserre ; Sime ; Teak, African (com.) ; Tema ; Ukloba ; Uloko ; Ulokoodigpe ; Uloko-nusingbon ; Vai.

Description of the wood from a specimen, No. 3051 "Odum," received from the Government of the Gold Coast, and another received from the Government of Nigeria, No. 3624. Our specimens Nos. 3067, 0750 HS., 0280 HS. and 2801 HS. from the G.C., No. 2191 HS. "Muvule" from Uganda, sent as *Sterculia* sp., and No. 0238 "Iroko" and No. 2991 from commercial sources, all agree.

GENERAL CHARACTERS.—A moderately hard and heavy wood of a nut-brown colour striated with buff. The colour varies in different specimens from grey through gold to brown. Prain (ex. Oliver, VI, p. 22) says, "white soon becoming pale bay." Unwin (1920, p. 253), "yellow-brown to dark-brown (oak to teak-brown)." Thompson (1908, p. 193), "it becomes almost black." Chevalier (1909, p. 261), "pale red, darkening on exposure to the air." The wood has a superficial resemblance to Teak. Surface bright, any lustre being due to the ground-tissue (wood-fibres). Grain, coarse, open, inclined ; some zigzag tracery in tangential section. Cool to the touch ; dry ; not likely to soil. Unwin mentions "an oily feel." Shade of the transverse section much lighter than that of the other sections on account of the quantity of pale soft-tissue (parenchyma). Smell, faint. Weathers to a Vandyke brown.

STRUCTURE.—Resembles that of the Fustic (*Machura tinctoria*).

*Transverse section.* (Prepared with glass-paper.)—See Pl. II, fig. 6.

Parenchyma of one kind (*a*) readily visible and even conspicuous, giving the tone to the section ; colour, light buff. In oblique and also in concentric lines, the latter predominating on the outer side of the ring ; interrupted but joining several groups of pores here and there (up to as many as sixteen groups), but thinning out between the groups to a thickness equal to about a semi-diameter of a large pore ; often anastomosing ; intervals between the lines about equal to two pore-diameters ;

more numerous in the outer zone of the ring; contents, crystals in abundance; proportion of the wood about one-quarter.

Vessels visible as perforations, large, diminishing little either in size or numbers; arrangement oblique (even when the P. (a) is ignored); widely isolated, 3-8 per sq. mm.; simple and in nested or radial groups of 2-4 pores, many pairs; shape, oval; contents, various, some white deposit, tyloses and black granules. Proportion of the wood about one-fifth.

Rays just visible; of one kind only; fine, almost too thin to taper; fairly regular in size and spacing; very weak and slightly avoiding the pores; intervals about four times the width of the rays themselves; proportion of the wood about one-quarter. Crystals present. Number per mm. 7-8.

Ground-tissue-cells visible with the macroscope.

Rings apparently defined, but true boundary is indefinite; there is some difference in density by zones; contour regular.

*Radial section.* Parenchyma (a) visible in vertical lines traceable over long distances. Vessels often twinned. Rays visible; colour, buff, nearly the same as that of the P. (a); dull. Rings not traceable.

*Tangential section* as the radial, but the P. (a) is very much more prominent as borders and tails to the vessels. Rays just visible with difficulty as a faint hatching on the darker ground; height, at least twenty cells, and usually more than one cell wide; not in parallel.

SAPWOOD "yellowish white; not wide. The slash is yellowish, with little red spots in it. A white latex exudes when cut" (Unwin, p. 254).

From specimen No. 2991—colour, oatmeal. The parenchyma becomes coloured in advance of the other tissues. The sapwood is well and sharply defined from the heartwood.

BARK.—"The yellow lenticels, especially on younger specimens and also on the red roots, are typical of the tree" (Unwin l.c.). "Bark grey, not deeply fissured; twigs purple" (Engler 1898, p. 52). "Bark thick, exuding a latex of a dirty white colour and very sticky (poisseux); wrinkled, slightly scaly and



of a greyish-white colour" (Comte de Briey, p. 114). "Bark whitish marbled with grey" (Chev., p. 261).

USES.—Already well known on the English market. "Canoes, pestles, rice-basins; the best wood for sleepers; very durable and termite-proof; white ants make little progress in the sapwood; some of the splendid Mupé canoes are made of this wood." There appears to be considerable difference between the male and the female trees. The wood of the former is the "darker, closer-grained and harder, and the sapwood is not so wide" (Unwin, pp. 26, 71, 215 and 253).

*Density*, No. 3051, 0.676, or about  $42\frac{1}{2}$  lb. per cu. ft.

"	"	0750, 0.6	"	$37\frac{1}{2}$	"	"
"	"	2191, 0.64	"	40	"	"
"	"	3067, 0.73	"	$45\frac{1}{2}$	"	"
"	"	0328, 0.788	"	49	"	"

Chevalier gives 0.721.

*Conservator's note*.—"A large deciduous tree of the mixed deciduous forest, fairly plentiful in parts of Nigeria. The timber is hard and durable, and is used more largely than any other in this country."

*Illustrations*.—Hopkinson 1912, p. 456, fig. 22, tr. sec. x. about 50. Fig. 23, ray in tang. sec. Fig. 24, ray-parenchyma with crystals.

**Akoto.** Not identified.

Specimen No. 3612 received from the Government of Nigeria (Lagos). Our specimens marked "Akoto" from the Gold Coast are quite unlike.

A wood of medium weight and hardness, of a brownish-yellow colour tinged with red, much resembling an inferior Mahogany. Grain, coarse, open and considerably inclined. Surface lustrous, dry and rather cool. Shade of the transverse section considerably darker. Smell, slight if any, perhaps recalling tan. Does not readily soil.

STRUCTURE. *Transverse section*. (Prepared with glass-paper.)

Parenchyma of one kind only: (a) readily visible to the unaided eye as sheaths surrounding the vessels and occasionally extending to short wings (tangentially) and more rarely uniting several vessels into more or less continuous lines;

colour, pinkish-buff. Proportion of the mass of the wood (including the vessels) about one-sixth.

Vessels distinctly visible as perforations, large, diminution but little ; occasional mother-and-daughter groups, mostly twos and threes, some fours ; number of vessels per sq. mm. 9-20. Arranged in oblique lines in well-developed rings (visible to naked eye). Shape, slightly oval. Apparently empty ?

Rays not visible without lens, very fine ; of one kind only ; regular in size, but rather less so in spacing, at intervals of rather more than the width of a ray to six times that width ; weak like silk threads ; number per mm. 15-22 ; proportion of the mass about one-quarter.

Ground-tissue-cells just visible with macroscope.

Rings apparently defined, but no definite boundary ; chiefly indicated by denser zones of tissue and a change in the direction of the oblique lines of vessels.

*Radial section* rather stripy (roey) in dull and lustrous bands. Grain, very cross, being so much inclined in places as almost to show transverse sections. Parenchyma just visible as hoary boarders and tails to the pores. Vessels with shining linings ; loculi on limit of vision ; empty except for occasional beads of red resin. Rays visible as very narrow, hoary flakes or lines ; from ten to twenty cells high. Rings indicated by the cross-grain only.

*Tangential section* as the radial, but the rays are only visible as a matt effect ; not in parallel, being rather in échelon ; mostly uniseriate, multiseriate rays present but rare. The indication of the rings is rather more distinct, being shown up by the loops of dense ground-tissue from which the vessels are absent or rare ; a distinct zigzag arrangement of the vessels in places.

SAPWOOD well, but not sharply defined from the heartwood, greyer and less brilliant. The colour of the heart commences to be apparent first in the vessels and rays.

BARK entire, somewhat resembling that of the Silver Fir, whitish with brown patches : lenticels numerous, extended laterally, brown. Texture granular. Of two layers of about equal thickness, the inner being purplish-red in colour and darker ; scleroses (stone-cells) small but abundant. Inner surface covered with much brown bast. Pith ?

*Density*, No. 3612, 0.78, or about  $48\frac{1}{2}$  lb. per cu. ft.

**Apara.** Not identified.

This wood, No. 3619, received from the Government of Nigeria (Benin, No. XII), listed as *Pentaclethra macrophylla* and marked "Apara" on the plank, cannot be that species. The native name is common to several species, and we imagine that an error has occurred in consequence. Amongst others, *Hexalobus crispiflorus*, A. Rich., passes by the name "Apara," and the specimen 3619 corresponds very well to the description given by Chevalier (1917, p. 49) of that species; the bark and the density respond to the same description. We throw this out as a suggestion.

**GENERAL CHARACTERS.**—A moderately hard and heavy wood of a dirty-white colour. Surface dull; grain, coarse, open and fairly straight; not cold to the touch, dry, soils readily. Shade of all sections somewhat similar. Smell, none when dry.

**STRUCTURE.**—Strongly recalls that of the Sapotaceæ, especially *Mimusops*.

*Transverse section.* (Prepared with broken glass.)

Parenchyma of two kinds: (a) narrowly sheathing the vessels and light in colour, and (b) in exceedingly numerous tangential bars from ray to ray, of a darker colour, at very regular intervals slightly less than those between the rays with which they make a very regular network; the bars are rather less than the rays in thickness. The area occupied by the whole of the parenchyma and the vessels is about one-quarter of the section.

Vessels just visible as perforations, and, on account of their parenchyma and arrangement, even prominent; size uniform; distribution characteristic, in échelon, the groups being linked up into long, straggling, radial, dendritic lines. Very unevenly scattered, there being areas of at least a sq. mm. without a single vessel, up to 24 per sq. mm. Few if any single pores, mostly radial groups of threes and fours. Shape, round or broadly oval; occasional black contents.

Rays visible with lens, very fine; colour as the parenchyma (b); sub-regular in size and spacing, being at intervals from twice to three times their own width; weak; 12–16 per mm. Proportion of the mass of the wood about one-third.

Ground-tissue-cells visible with the macroscope on account of their (apparently) crystalline contents; rather more than one-third of the mass.

Rings apparently defined to the naked eye by variation in colour, but no definite boundary can be determined with the lens.

*Radial section.*—Grain, coarse, brown on account of the colour of the linings of the vessels; the pores come out in zigzag patches. Parenchyma (*a*) obscure from lack of colour; P. (*b*) in fine vertical lines covering nearly one-quarter of the surface, but the lines themselves are apparent only with the macroscope. Rays visible by reflection as dull narrow flakes.

*Tangential section.*—As the radial, but the rays are only just visible with the lens, and then only when by decay they become more prominent; height up to twelve cells by one cell wide. Vessels more regularly distributed than in the radial section.

Pith? SAPWOOD. Not differentiated from the heart-wood.

BARK.—Silvery-grey, scaling in small, longitudinal flakes and exposing the brown subjacent layer. The scales are very thin. Total thickness of bark (of sp. No. 3619) about  $\frac{1}{4}$  inch. Inner substance brown, consisting of many exceedingly thin layers which are visible with lens.

*Density*, No. 3619, 0.66 or about 41 lb. per cu. ft.

“Oregbo Erin.” Not identified.

Leguminosæ?

Specimen 3615 received from the Government of Nigeria (Lagos).

GENERAL CHARACTERS.—A hard and heavy wood of a pleasing nut-brown colour relieved by loops and zigzags of a paler shade much resembling the old-fashioned Partridge wood (*Andira inermis*). Surface clean. Hardly cold to the touch; dry. Grain, rather coarse, open and fairly straight. Transverse section darker and hornier than the other sections. Smell, none.

STRUCTURE.—Resembles that of *Pterocarpus* (c.f. Fig. 2, Pl. II).

*Transverse section.* (Prepared with glass-paper.)

Parenchyma of one (?) kind: (*a*) sheathing the vessels and extending tangentially to sub-continuous undulating lines occasionally anastomosing, very numerous, at intervals of about  $2\frac{1}{2}$ –3 times their own width. Colour, light brown; contains many minute globules of a darker brown. Width very variable from one-half diameter of a large pore to rather more than the long diameter; number per mm. 2–4. Distribution uniform; proportion of the section about one-third (including the pores). There are many very fine lines running from ray to ray which may be parenchyma (*b*), but they are absent over quite considerable areas; further investigation will be necessary before determining the precise nature of these lines.

Vessels visible as perforations to the naked eye, large but very variable in size; very few in numbers, 0–3 per sq. mm., widely isolated; comparatively few simple vessels, mostly groups, both radial and-nested, of from 2–7. Contents, some yellow globules. Shape, roundish.

Rays visible to good sight, fine, of a similar colour to the parenchyma (*a*) but a little lighter; sub-regular in spacing but fairly regular in size, of one kind only; at intervals of from three to six times their own width; fairly straight; number per mm. 8–10. Proportion of the mass of the wood rather less than one-quarter.

Ground-tissue-cells just visible with the macroscope in places; proportion of the mass nearly half.

Rings not traceable.

*Radial section.*—Colour brown in alternating striæ of darker and lighter tints like machine-ruling; grain, medium, coarse, but few pores exposed on this section; those which are seen contain glistening sulphur-coloured globules. Parenchyma (*a*) very abundant and even prominent in borders, and tails to the pores, and continuous vertical lines between them. The lines above referred to are occasionally visible with the macroscope as short lengths of a single cell in width. Rays readily visible by reflection, not prominent.

*Tangential section* as the radial, but the rays are short, fine, hoary, spindle-shaped lines visible with the lens; not in parallel; height up to .5 mm. and one to three cells wide.

Parenchyma (*a*) comes out very boldly and prettily, forming a partridge-feather pattern in places.

Pith ? Sapwood ? Bark ?

*Density*, No. 3615, 0.90, or about 60 lb. per cu. ft.

“**Papapa.**” Not identified.

Specimen No. 3614 received from the Government of Nigeria (Lagos).

**GENERAL CHARACTERS.**—A very hard and heavy wood of a brown colour of varying shade and tints. Surface clean; grain, medium, open and cross; not cold to the touch. Shade of the transverse section darker than that of the others. Smell, none.

**STRUCTURE.**—Somewhat resembles that of *Lophira procera* (compare fig. 1. Pl. II) on a smaller scale.

*Transverse section.* (Prepared with the plane.)

Parenchyma of one kind (*a*) only, sheathing the pores and extending tangentially in undulating, concentric lines of considerable length, sub-continuous, occasionally interrupted and infrequently anastomosing; just visible from their lighter colour, which is brown; very numerous and regular in spacing at intervals of about twice the long diameter of a large pore; distribution uniform throughout the section; proportion of the mass of the wood (including the vessels) about one-fifth.

Vessels visible (on a planed surface) as minute perforations; size uniform except in the groups; 1–14 per mm. Simple for the most part, many pairs, but few if any threes; shape, slightly oval; mostly empty.

Rays just visible with lens, very fine and numerous; weak and undulating like silk threads, of one kind only; colour as the lines of parenchyma, but slightly darker; number per mm. 22–28; at intervals of from two to three times their own width; proportion of the mass quite one-third.

Ground-tissue-cells not visible with the macroscope; very deep sherry to deep brown colour and horny in appearance; proportion of the mass approximately one-third.

Rings not traceable.

*Radial section* very much resembles the tangential as the rays are very obscure, visible under close observation as fine dull lines or narrow flecks. Colour rather stripy. Parenchyma

appears as very fine vertical lines just visible with the naked eye, also as obscure tails and borders to the pores.

*Tangential section* as the radial, but the parenchyma comes out in a fine zigzag tracery, and the rays are only visible with the macroscope, being exceedingly fine, mostly unicellular lines.

Pith ? Sapwood ? Bark ?

*Density*, No. 3614, 1.06, or about 66 lb. per cu. ft.

## KEY TO THE SPECIES

1. White or nearly white woods (ecru, oatmeal colour, etc.)	2
1a. Woods of pronounced colour	6
2. Soft woods	3
2a. Compact woods (from, say, the hardness of Spruce to that of Oak)	15
3. Woods that are too soft for ordinary uses (except perhaps for floats)	4
3a. Soft woods, but still fit for, say, drawer-bottoms	5
4. Rays (seen on a cross-section prepared with glass-paper) very fine	70
4a. Rays rather coarse and readily visible	17
	<i>Eriodendron</i> , page
5. Rays (on glass-papered cross-section) fine and apparently all of the same size ; they make a network with a series of concentric lines which are nearly equally fine	66
	<i>Alstonia</i> , page
5a. Rays rather coarse, readily visible, and apparently of very diverse thicknesses. No concentric lines visible with lens	19
	<i>Triplochiton</i> , page
6. Coloured woods—Browns of various shades	7
6a. Colours other than brown (red, yellow, green, etc.)	17
7. Heavy brown woods	8
7a. Comparatively light brown woods (say of the weight of Mahogany or less). (Medium weights are included in both categories)	24
8. The pores (vessels) on cross-section are connected by long, light-coloured lines or bands	9
8a. The pores are isolated from one another or in short series only	12
9. The light-coloured concentric lines are very readily visible to the unaided eye	10
9a. The lines are very fine and may need the lens	43

The Key being constructed on simple and popular lines adapted to the use of those who have but little knowledge of the structure of wood, is subject to the defect of too great generality, i.e. expressions such as "hard, soft, light, heavy," and the colours, which are very variable, must be allowed for. When in doubt as to which alternative to choose try first one and if it leads to an obvious error, try back and follow the second. Check by the descriptions. See notes, p. 87, and descriptions of plates.



10.	Woods striated in radial section (quartered wood) showing zigzags in tangential section (plank-wise).	11
10a.	Wood not striated though sometimes broadly striped, otherwise uniform in colour; heavy; reddish to purplish-brown	14
11.	The structure, striæ and zigzags very bold	
	<i>Afzelia</i> , No. 2823, page	40
11a.	Striations and zigzags delicate	46
12.	Colour yellow to brown or reddish-brown or yellow striped with brown	37
12a.	Colour nut-brown to purplish-brown	13
13.	Cross-section shows fine bars from ray to ray (needs microscope). Colour deep nut-brown (cf. tr. sec. fig. 6, Pl. III)	56
	<i>Casearia</i> , page	
13a.	No such fine bars from ray to ray	50
14.	Colour reddish-brown; concentric lines usually visible	
	<i>Albizzia</i> , page	52
14a.	Colour purplish-brown; concentric lines not visible without lens	81
	<i>Papapa</i> , page	
15.	Colour pure white; rays rather large and readily visible; ring-boundary vague (cf. tr. sec. fig. 4, Pl. IV)	11
	<i>Scottellia</i> , page	
15a.	Colour dirty white; boundary of the ring fine but prominent	16
16.	Colour white or sometimes yellowish, especially on the cross-section. Pores isolated from each other (cf. tr. sec., fig. 6, Pl. IV)	55
	<i>Terminalia</i> sp., page	
16a.	Colour dirty white to brownish. Pores connected by pale and obscure lines of soft tissue (cf. tr. sec., fig. 5, Pl. IV)	53
	<i>Terminalia superba</i> , page	
17.	Colour green or greenish-brown, metallic lustre (cf. tr. sec., fig. 1, Pl. III)	47
	<i>Cylicodiscus</i> , page	
17a.	Colour red or yellow	18
18.	Reds	19
18a.	Yellows	22
19.	Heavy red woods	20
19a.	Light weight to medium weight	36
20.	Colour deep red like that of dried blood; much chalky matter in the grain (cf. tr. sec., fig. 1, Pl. II)	
	<i>Lophira</i> , page	14
20a.	Colour brownish-red to rich crimson; no chalky matter	49
21.	Colour buff, surface dry	64
	<i>Mitragyne</i> , page	
21a.	Colour yellow or yellow striped with brown, surface sticky	62
	<i>Adina</i> , page	
22.	Pores in cross-section (glass-papered) prominent and in straggling lines	40

# GUIDE TO TIMBERS OF NIGERIA

85

22a. Structure fine, pores small . . . . .	23
23. Surface dry . . . . .	44
23a. Surface sticky . . . . . <i>Adina</i> , page	62
24. Structure very prominent to the unaided eye . . . . .	25
24a. Structure obscure (needs lens) . . . . .	32
25. Pores connected concentrically by light-coloured lines throughout the cross-section (not counting the boundary line of the ring if present) . . . . .	26
25a. Pores isolated or in short oblique series only (not counting the boundary line if present) . . . . .	27
26. Wood resembles a coarse-grained Mahogany with a yellow tinge, quartered surface glossy; concentric lines present throughout the whole cross-section and very clear with lens (cf. tr. sec. fig. 5, Pl. II) <i>Garcinia</i> , page	12
26a. No resemblance to Mahogany; concentric lines rather wide, but in some species very obscure from want of contrast, in others very prominent . . . . .	45
27. Boundary a fine line of light-coloured tissue (sometimes interrupted) . . . . .	28
27a. Boundary a zone of darker tissue (wood-fibres) . . . . .	29
28. Colour a warm, rich brown; rays in tang. sec. (plank-wise) in parallel lines causing a "ripple" (lens: cf. fig. 10, Pl. I, also tr. sec., fig. 3, Pl. II) <i>Paradaniellia</i> , page	35
28a. Colour neutral brown to nut-brown; rays not in parallel . . . . .	30
29. Colour whitish to greenish-yellow. Pores on cross-section (glass-papered) very prominent as light-coloured points (cf. tr. sec., fig. 6, Pl. IV) <i>Terminalia</i> sp., page	55
29a. Colour brownish to Walnut-colour . . . . .	35
30. Pores isolated (except those on the boundaries of the ring) . . . . .	41
30a. Pores connected in short, oblique series (cf. tr. sec., fig. 6, Pl. II) <i>Chlorophora</i> , page	73
32. Colour reddish-brown; rays red . . . . .	48
32a. No reddish tinge; rays not red . . . . .	33
33. Colour Walnut; much black matter in the pores which sometimes runs to prominent black streaks (gum-galls) (cf. tr. sec., fig. 3, Pl. IV) <i>Lovoa</i> , page	28
33a. Colour buff to dirty white, yellow or brown . . . . .	34
34. Buff to yellowish; structure in cross-section very fine, pores very small . . . . .	21
34a. Dirty white to brownish; pores coarse but few and wide apart (cf. tr. sec., fig. 5, Pl. IV) <i>Terminalia superba</i> , page	53
35. Pores apparently crowded to the unaided eye . . . . .	47

- 35a. Pores widely isolated ; little black matter in the grain,  
no gum-galls . . . . . *Piptadenia*, page 49
36. Colour crimson (at least on the cross-section) . . . 42
- 36a. Colour red with a brownish tinge ; pores isolated,  
rays red (in cross section) (cf. tr. sec., fig. 2, Pl. IV)  
*Khaya*, page 26
37. Brown with a greenish tinge (weathers dark brown)  
(cf. tr. sec., fig. 1, Pl. III) . . . *Cylicodiscus*, page 47
- 37a. Yellow or some other shade of brown . . . . . 38
38. Pores very prominent in cross-section, on account of  
their wide borders . . . . . 39
- 38a. Pores very small and obscure, need lens. Colour  
yellowish to nut-brown . . . *Adina*, page 62
39. Reddish-brown rich colour (cf. tr. sec., fig. 4, Pl. III)  
*Afzelia*, page 37
- 39a. Neutral brown (cf. tr. sec., fig. 3, Pl. III)  
*Erythrophleum*, No. 3292, page 43
40. Colour an intense yellow ; wood heavy and hard (cf. tr.  
sec., fig. 1, Pl. IV) . . . *Sarcocephalus*, page 57
- 40a. Very pale yellow though somewhat deeper (citron) on  
the cross-section (cf. tr. sec., fig. 6, Pl. IV)  
*Terminalia* sp., page 55
41. Colour a dull brown ; boundary-line continuous and  
frequently repeated (cf. tr. sec., fig. 2, Pl. III)  
*Brachystegia*, page 41
- 41a. Warm brown ; boundary-line rarely developed (cf. tr.  
sec., fig. 3, Pl. III) *Erythrophleum*, No. 3292, page 43
42. Pores connected by lines of light-coloured tissue (cf. tr.  
sec., fig. 2, Pl. II) . . . *Pterocarpus*, 1992, page 34
- 42a. Pores isolated, but having broad light-coloured borders  
(cf. tr. sec., fig. 3, Pl. III)  
*Erythrophleum*, No. 2997, page 46
43. Zigzags on tang. sec. (plank-wise) very prominent ;  
pores filled with debris of a whitish colour (cf. tr. sec.,  
fig. 1, Pl. II) . . . *Klainedoxa*, page 23
- 43a. Zigzags very fine and need attention to find ; pores  
filled with debris of a deep brown colour (lens)  
*Papapa*, page 81
44. Pores seen with macroscope on cross-section, mostly in  
radial groups of 2-4 pores ; the rays are direct and  
do not run round the pores *Swamp Opepe*, page 60
- 44a. Pores (macro.) mostly single, a few pairs ; the rays  
spread out at the point where they pass the rays  
*Excoecaria*, page 72
45. Lines of light-coloured tissue exceptionally prominent  
*Afzelia*, No. 2823, page 40
- 45a. Lines of light-coloured tissue less prominent on account  
of the lack of contrast . . . . . 51

46. Colour light brown (fawn colour) splashed with lustrous patches ; concentric lines of parenchyma nearly as wide as the darker zones between them (cf. tr. sec., fig. 4, Pl. II) . . . . . *Guarea*, page 24
- 46a. Nut-brown ; concentric lines very fine . . . . . *Oregbo Erin*, page 79
47. Rays in cross-section, light brown or colourless (cf. tr. sec., fig. 3, Pl. IV) . . . . . *Lova*, page 28
- 47a. Rays red in transverse section ; in radial section they are prominent and pretty flakes . . . . . *Uapaca*, page 69
48. Rays in radial section (quarter) are very narrow lines about  $\frac{1}{16}$  inch or less (cf. tr. sec., fig. 2, Pl. IV) . . . . . *Khaya*, page 26
- 48a. Rays in radial section rather broad flakes (about  $\frac{1}{8}$  inch high) . . . . . *Uapaca*, page 69
49. Pores isolated (cf. tr. sec., fig. 3, Pl. III) . . . . . *Erythrophleum*, No. 2997, page 46
- 49a. Pores connected by light-coloured lines in transverse section (cf. fig. 2, Pl. II) . . . . . *Pterocarpus*, No. 3623, page 31
50. Pores not connected in cross-section by light-coloured lines ; wood of a purplish-brown colour . . . . . *Saccoglottis*, page 21
- 50a. Some of the pores are connected by light-coloured tissue ; wood chestnut-brown in colour (cf. tr. sec., fig. 3, Pl. III) . . . . . *Erythrophleum*, No. 3292, page 43
51. Colour a warm brown ; concentric lines of parenchyma nearly as wide as the zones of dark tissue between them (cf. tr. sec., fig. 4, Pl. II) . . . . . *Guarea*, page 24
- 51a. Colour dirty white ; concentric lines obscure, few and wide apart (cf. tr. sec., fig. 5, Pl. IV) . . . . . *Terminalia superba*, page 53

## NOTES TO THE KEY

1. Transverse section is always to be understood unless otherwise specified. The method of preparation of the surface of the wood is as stated in each schedule under "Transverse section."
2. "Vasicentric, perivascular or paratracheal" parenchyma, which we refer to for the sake of brevity as P. (a) is well shown in all figures on Plates II and IV, and diagrammatically in figs. 1, 4, 5 and 7-9, Pl. I, where it is reduced to simple narrow aureoles around the orifices of the vessels. When better developed it may extend to wings or even long lines (figs. 2 and 3, Pl. I, and all figures on Pl. II), but it is always in intimate connection with the vessels. Before coming to a decision, the vertical sections should be examined, as this kind of parenchyma, when very scanty and scarcely visible on the transverse section, may come out as borders or tails to the pores on a vertical section.

3. The "metatracheal" parenchyma which we shall call P. (b) is that which is characteristic of the common Walnut and Hickories, being very prominent in the latter, where it is sometimes visible to the unaided eye. In the European Beech and in the Hornbeam, this kind of Parenchyma lacks contrast with the woody fibres and can only be seen in a transparent section. Rarely if ever does the P. (b) exceed one cell in (radial) thickness; thicker zones are composed of P. (a), see previous note and compare fig. 5, Pl. I.
4. The concentric parenchyma (c) which is histologically the same as P. (a) frequently closes the season's growth, hence it is often called "terminal" parenchyma (cf. figs. 1-4, Pl. I and fig. 2, Pl. III). An example of a wood in which it may be readily seen is the Cigar-box Cedar. We treat this third form of P. (c) separately for the sake of convenience.
5. *Alstonia* is a rare case (the only one that we have yet met with) in which the concentric zones of P. are so closely arranged that as many as three zones may appear in the space equal to the radial diameter of a pore-group.
6. *Festoons*. In this arrangement of the vessels the latter are in oblique lines inclined towards each other and joined at their ends by P. (a), thus forming a strongly-waved line (see fig. 3, Pl. I, and fig. 6, Pl. II).
7. When the lines of P. (a) are only gently undulating, but uninterrupted the pores look like beads strung upon a string. Figs. 2, Pl. I, and 1 and 2, Pl. II.
8. "Herring-bone" arrangement of the vessels. This is well shown in fig. 1, Pl. III. The vessels are disposed in oblique, more or less parallel lines. The lines may reverse their direction from zone to zone. Herring-bone is apt to be lost in badly developed rings.
9. Particular care should be taken to search for the widest rings and to ignore the narrower ones.
10. The rays in tangential section when all of the same height are found to be arranged either in parallel rows which produce a fine stippling that is visible to the naked eye, or they are in *échelon*, which may be a modification of the other produced by spiral grain. See fig. 10, Pl. I, in parallel, and fig. 13, Pl. I, in *échelon*.
11. Rays are more usually of very diverse heights, in which case they are never arranged in parallel. The height runs from a certain maximum characteristic of the species down to a single cell. When the extremes are considerable a different appearance is observable in tangential section to that produced when the difference in height is little (cf. fig. 11, Pl. I, proportionately low; fig. 12, proportionately high).
12. Unless otherwise stated, proportion of parenchyma to the total mass, includes the area occupied by the pores.

Fig. 1.



Fig. 2.

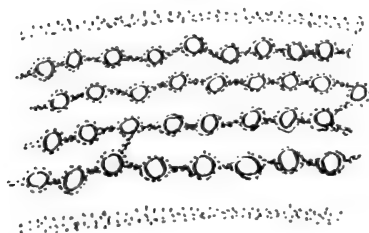


Fig. 3.

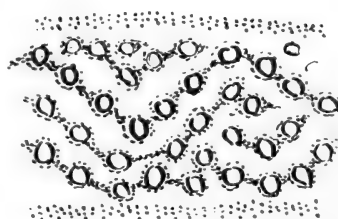


Fig. 4.

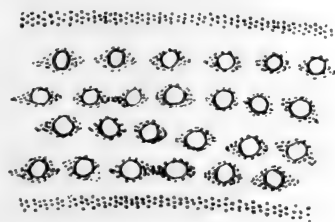
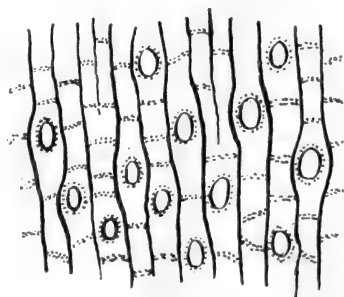
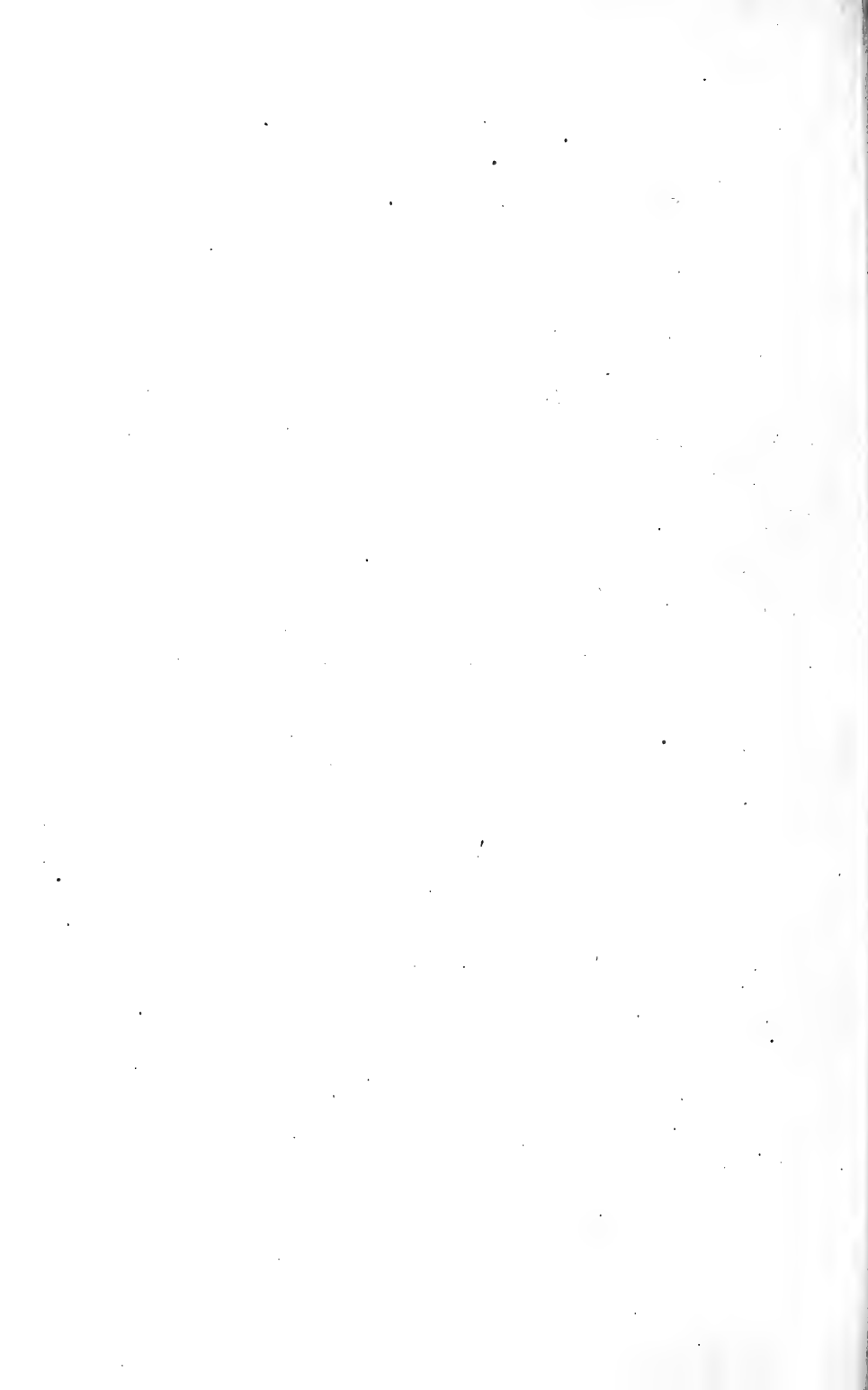


Fig. 5.





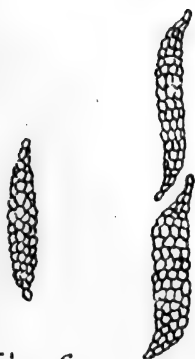


Fig. 6.



Fig. 7.

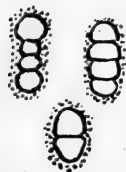


Fig. 8.

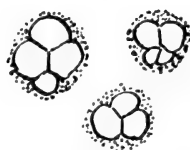


Fig. 9.

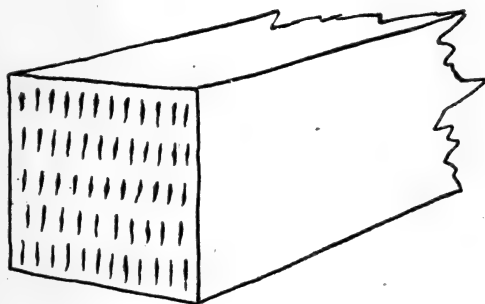
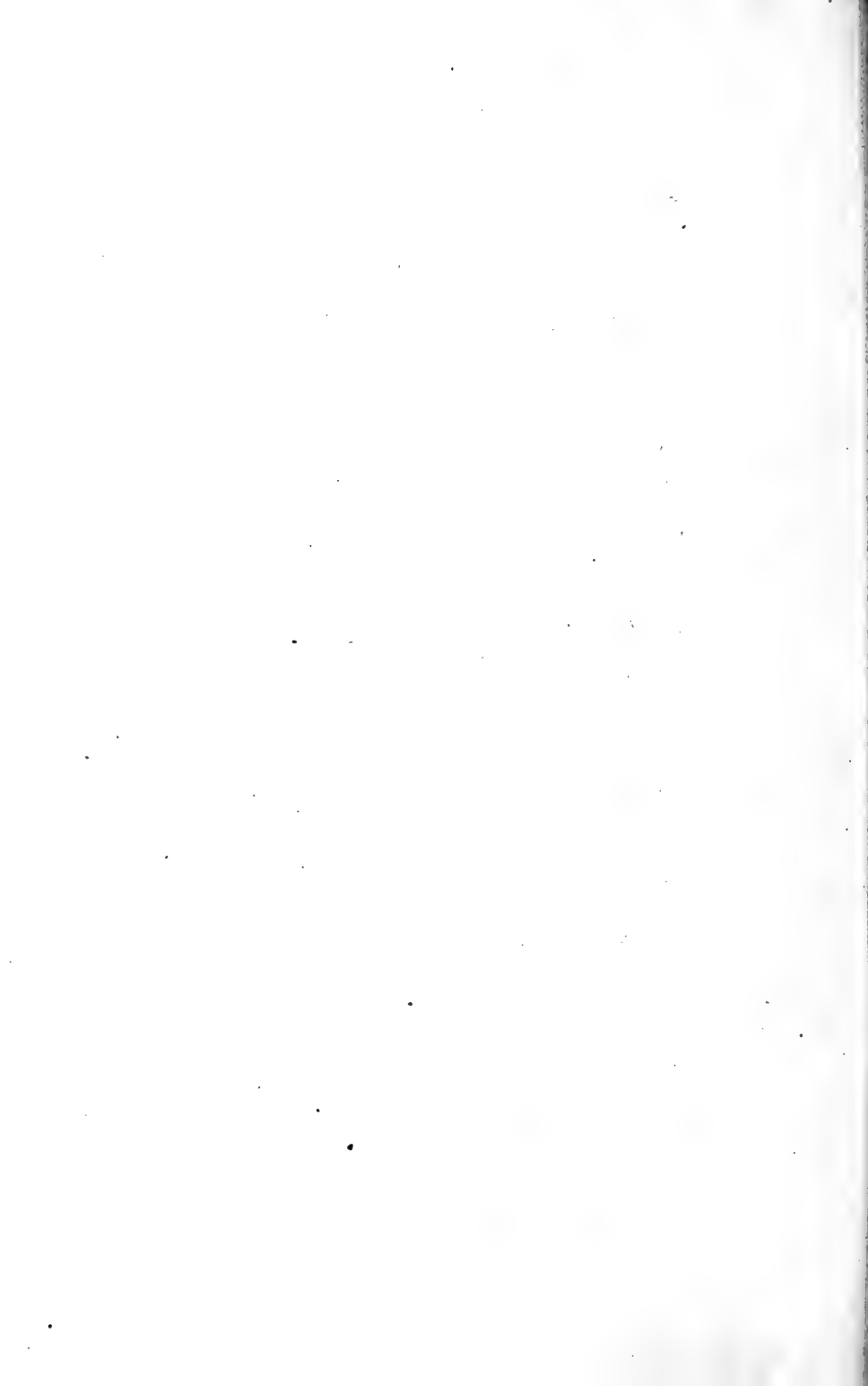


Fig. 10.





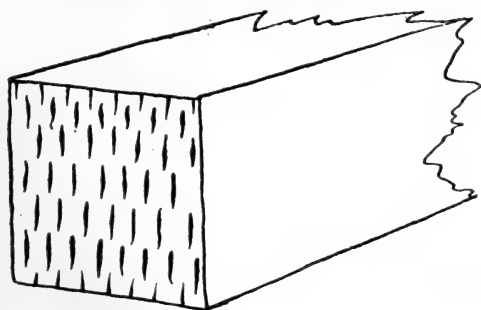


Fig. 11.

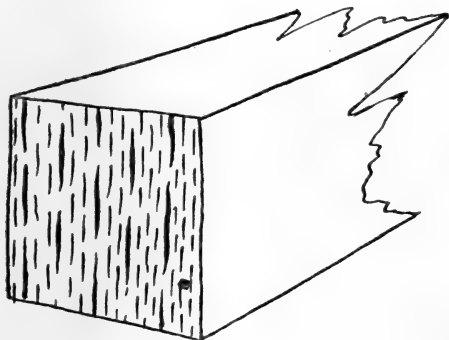


Fig. 12

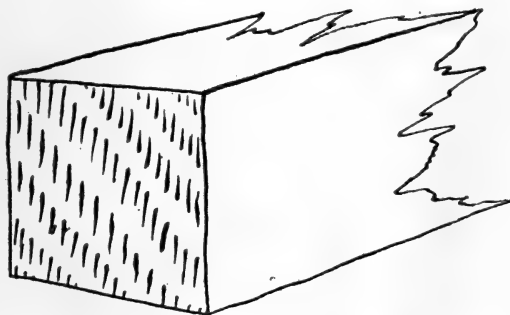


Fig. 13.

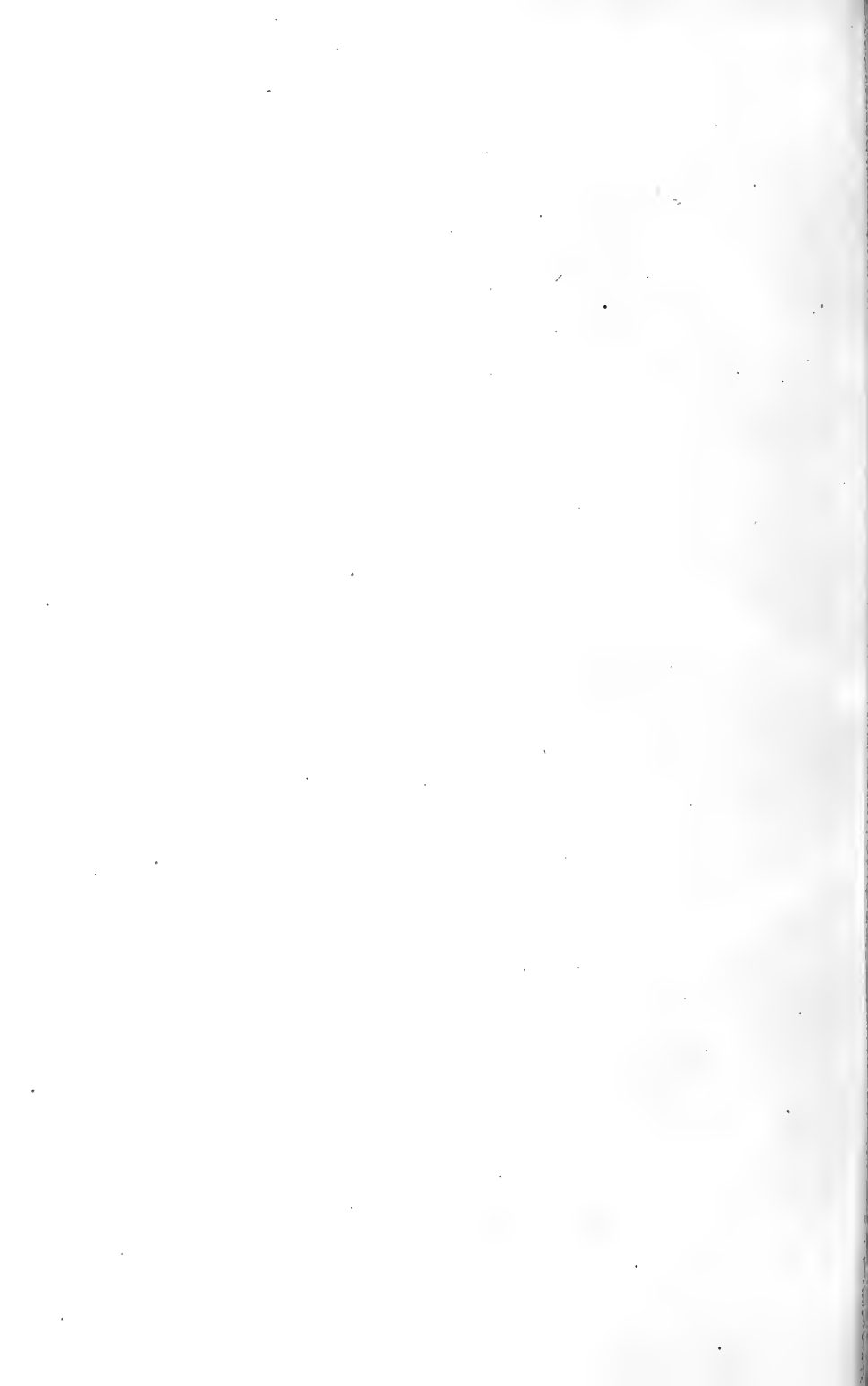


PLATE II

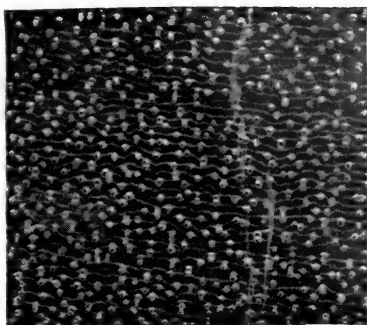


FIG. 1.

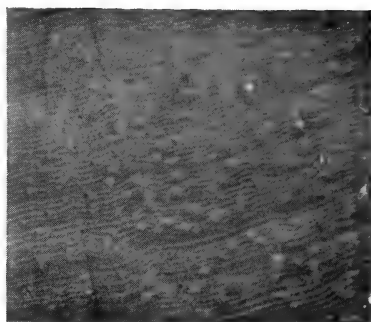


FIG. 2.

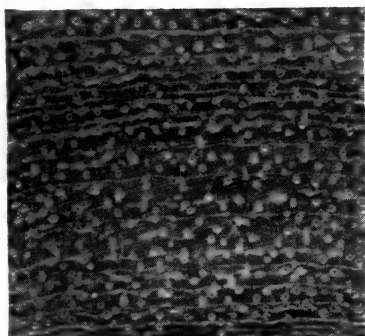


FIG. 3.

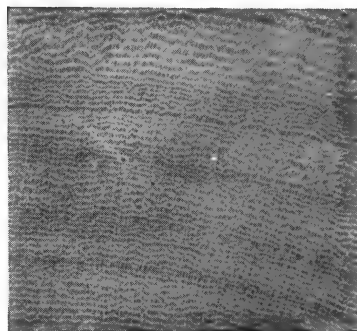


FIG. 4.

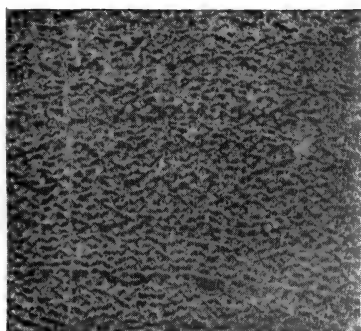


FIG. 5.

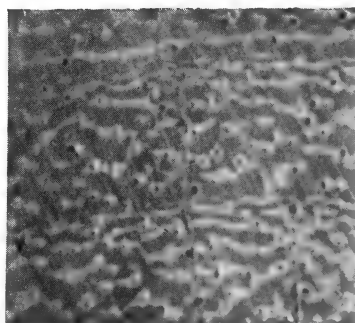


FIG. 6.

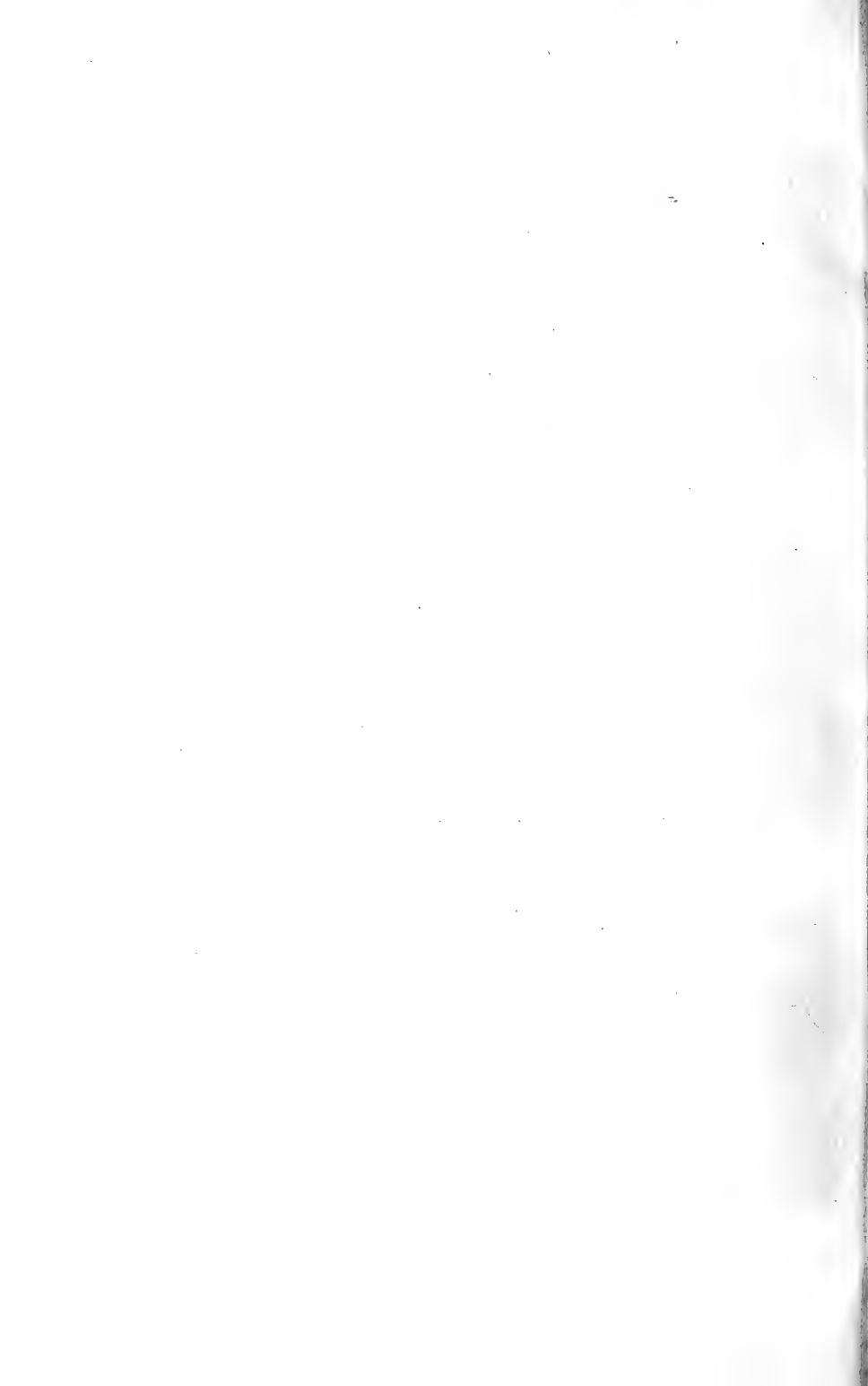


PLATE III

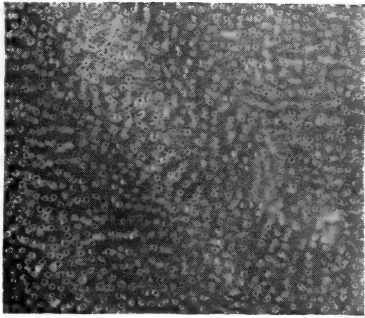


FIG. 1.

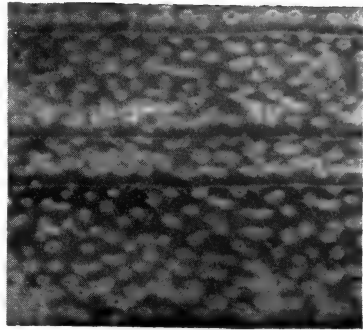


FIG. 2.

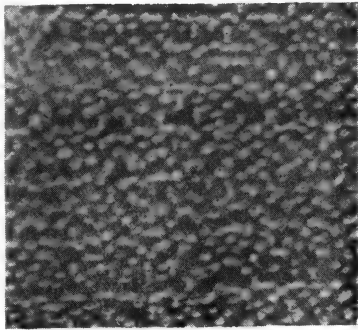


FIG. 3.

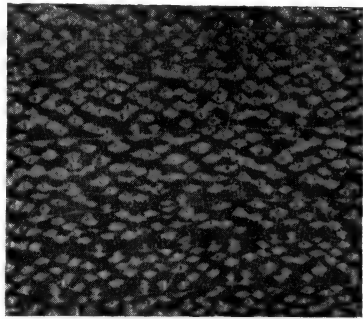


FIG. 4.

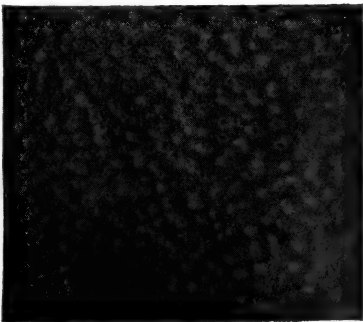


FIG. 5.

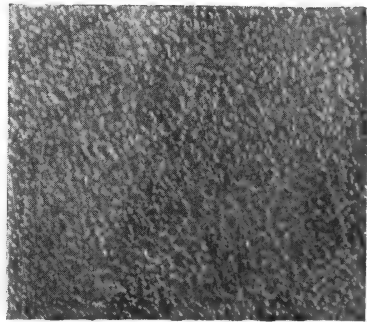


FIG. 6.

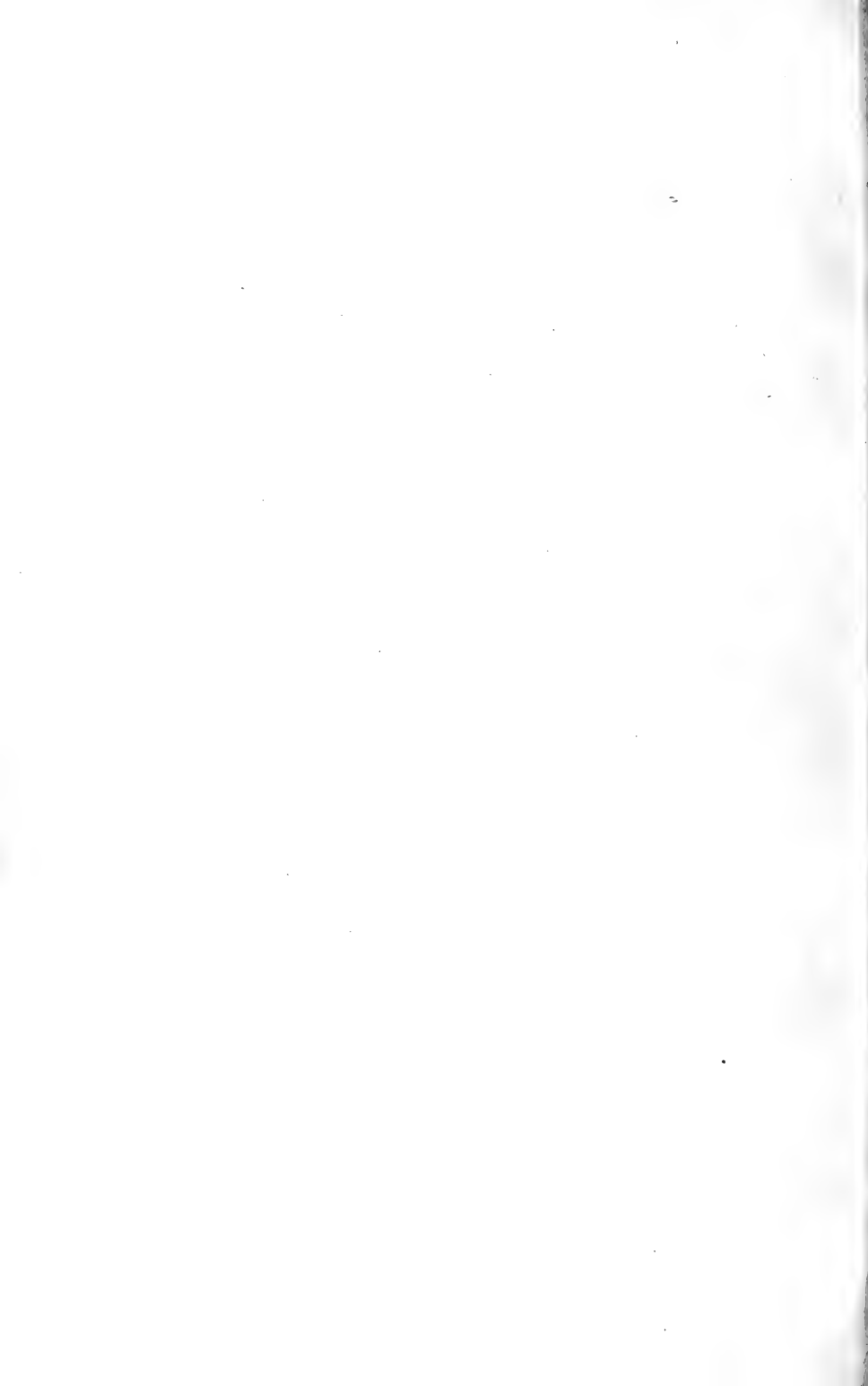


PLATE IV

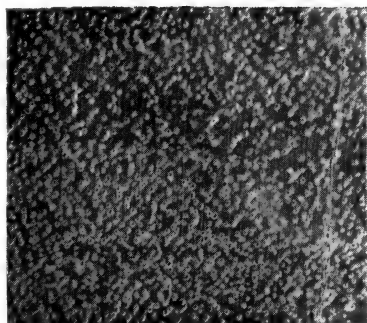


FIG. 1.

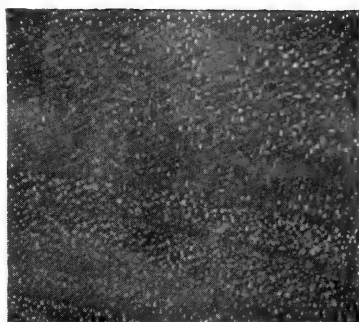


FIG. 2.

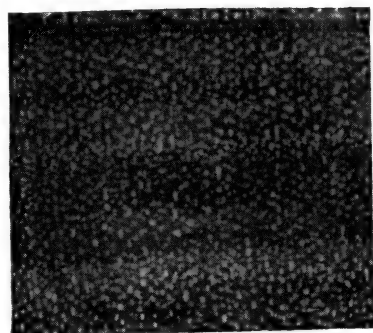


FIG. 3.

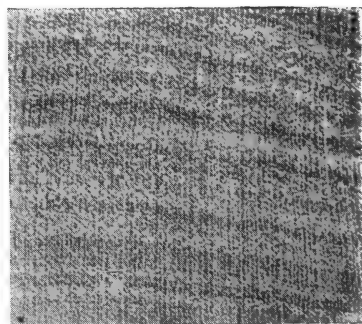


FIG. 4.

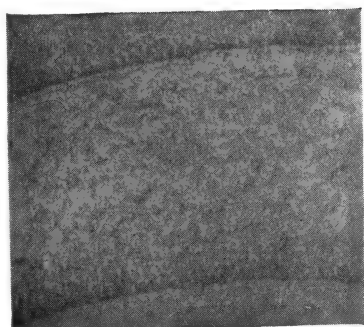


FIG. 5.

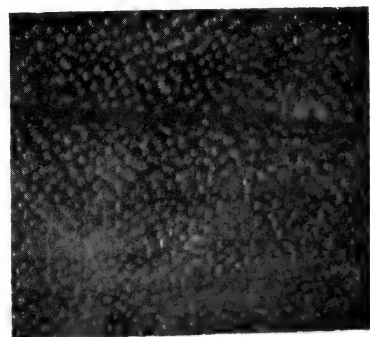


FIG. 6.





## DESCRIPTION OF THE PLATES

### PLATE I

- FIG. 1. Diagram representing portions of two rings (pith side down, transverse section.) The horizontal dotted lines indicate boundaries of concentric, terminal Parenchyma (*c*). The small circles indicate the pores or vessels which are more or less evenly scattered in the upper ring, but incline to be arranged in oblique lines in the lower ring. In the latter case the pores of a wood under a low magnification will appear to be arranged in a "herring-bone" fashion. The dots around the pores indicate the Parenchyma (*a*), which in this case is an ill-developed form in aureoles or borders to the orifices.
- FIG. 2. Portion of a ring (transverse section) limited by concentric terminal Parenchyma (*c*). The perivascular or vasicentric parenchyma, which we term P. (*a*) for the sake of brevity, is well developed and extends laterally to continuous lines linking the pores together.
- FIG. 3. Another form of Parenchyma (*a*), where the lines linking the pores are strongly undulating and usually much interrupted. These waved lines we term "festoons."
- FIG. 4. Portion of a ring with pores sheathed with Parenchyma (*a*) a little better developed than in fig. 1, inasmuch as it extends occasionally to short wings.
- FIG. 5. Portion of the transverse section of a wood showing Parenchyma (*b*), i.e. that which is disposed concentrically (tangentially), but in the form of small bars from ray to ray. The vertical lines represent the rays. Note that two of the rays terminate as "thin ends." The number of such thin ends between two "middles" is often a good diagnostic feature.
- FIG. 6. Diagram of rays in tangential section. The ray to the left is more or less regular in shape; the other two are "distorted."
- FIG. 7. Radial groups of vessels (in transverse section) joined by Parenchyma (*a*) into a group. The vessels are, however, quite separate and independent of each other.
- FIG. 8. Radial "mother-and-daughter" groups of vessels surrounded by Parenchyma (*a*). The vessels are closely pressed against each other as though they had arisen from the subdivision of the same mother cell.

- FIG. 9. Nested (mother-and-daughter) groups surrounded by Parenchyma (a).
- FIG. 10. Block of wood showing the tangential section where the rays appear in parallel lines ("storied" or "palisade" arrangement).
- FIG. 11. Block as in fig. 10, but the rays are arranged alternately in "quincunx." They are, however, all about the same height as in previous figure.
- FIG. 12. As fig. 11, but the difference in height of the rays varies very much from point to point.
- FIG. 13. The rays in this case are more or less uniform in height, but they are arranged in oblique lines or in échelon.

## PLATE II

TRANSVERSE SECTIONS, PITH SIDE DOWNWARDS, X. 3, PHOTOGRAPHED FROM THE SOLID WOOD BY A. J. WILSON

- FIG. 1. *Lophira*. Shows widely isolated vessels sheathed with and connected by gently undulating, narrow zones of Parenchyma (a), the so-called "perivasal, vasicentric or paratracheal" Parenchyma. This photo serves for *Klainedoxa* also.
- FIG. 2. *Pterocarpus*. A type serving for all species of the same, and several allied genera of Leguminosæ, e.g., *Baphia* (Camwood). It is generally accompanied by rays in palisade (storied) rays. The resemblance of this type to fig. 1 is superficial only.
- FIG. 3. *Paradaniellia*. A modification of type in fig. 2. The lines of P. (a) are more interrupted in certain zones.
- FIG. 4. *Guarea*. The lines of P. (a) are more ragged in contour than in the previous figures. The lines vary in thickness, spacing, and regularity, from place to place, according to differences in the rapidity of growth.
- FIG. 5. *Garcinia*. The lines of P. (a) are still more ragged in contour than in previous figures, and the tendency to run obliquely and to branch is greater, making loose festoons. (The white line to the left is a crack in the wood.)
- FIG. 6. *Chlorophora*. The P. (a) is very well developed and forms broken festoons and more or less continuous boundary-like lines at intervals.

## PLATE III

TRANSVERSE SECTIONS, PITH SIDE DOWNWARDS, X. 3, PHOTOGRAPHED BY A. J. WILSON FROM THE SOLID WOOD

- FIG. 1. *Cylicodiscus* (pith side to the left below). The P. (a) sheathes the vessels but does not connect them. Radially-oblique series of vessels are well shown reversing their direction from zone to zone.

- FIG. 2. *Brachystegia*. The P. (a) sheathing the vessels is in somewhat lozenge-shaped patches, and sometimes unites two pore-groups. A fine sub-continuous line of P. (c), together with a denser pore-less zone of wood, appears to form the limit of the ring.
- FIG. 3. *Erythrophloeum*. A less pronounced type than fig. 2. The lozenge-shaped sheaths and the ring-boundaries are but little developed.
- FIG. 4. *Afzelia*? A modification of the type in fig. 2, the lozenge-shaped patches around the vessels being well shown, as is also the very fine boundary-line (just visible in the figure).
- FIG. 5. *Piptadenia*. The P. (a) is well developed, but only as aureoles or annular sheaths around the vessels.
- FIG. 6. *Casearia* (pith side to right below). The P. (a) very narrowly sheathes the vessels, but sufficiently to make them apparent. The vessels tend to arrange themselves into straggling, radial series.

## PLATE IV

TRANSVERSE SECTIONS, PITH SIDE DOWNWARDS, x. 3, PHOTOGRAPHED FROM THE SOLID WOOD BY A. J. WILSON

- FIG. 1. *Sarcocephalus*. The P. (a) is just visible sheathing the vessels. The vessels tend to crowd in the badly-grown rings and to thin out in the wider ones.
- FIG. 2. *Khaya*. This is the usual type of the Mahoganies (Meliaceæ), but very little is to be made out from a photograph. The boundary lines of P. (c), which can just be seen, are absent in some of the African Mahoganies. The vessels are rare and widely isolated in some places.
- FIG. 3. *Lovoa*. A very common type amongst the Meliaceæ. The sheaths or aureoles of P. (a) are visible around the vessels, but the latter are rarely if ever joined together by them. There is a tendency to oblique lines amongst the vessels. The two dark parallel lines (top) are rows of "gum-galls."
- FIG. 4. *Scotellia*. The tissue contains very little Parenchyma; the vessels are small and close; the rays (running vertically) are rather large.
- FIG. 5. *Terminalia superba*. The festoons of P. (a) can hardly be made out. They connect the very rare, widely isolated vessels. The boundary-zone of dense wood is very characteristic of this wood.
- FIG. 6. *Terminalia* sp. This appears to be of quite a different type to the last as the P. (a) is very little developed indeed.

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## INDEX

- Aaha, 53  
 Abe, 49  
 Abo, 67  
 Abo-ogea, 36  
 Abura, 64  
 Abuwe, 29  
 Abwang, 74  
 Adadawa, 47  
 Adesekanchie, 58  
 Adina, 84, 85, 87  
 — *microcephala*, 62  
 — — *var. Galpini*, 62  
 Adioumkué, 23  
 Adja, 38  
 Adya, 38  
 Afara, 53  
 Affna, 60, 62  
 — sappa, 60, 62  
 Affram, 53  
 Afrodaniella, 35  
 Afzelia, 84, 86, 87, Pl. III  
 — *africana*, 37  
 — *bracteata*, 38  
 Agaiji, 47, 49  
 Aga-iji, 47, 49  
 Agbassy, 58  
 Agberigbede, 12  
 Agberigeddi, 41  
 Agberignede, 12  
 Agbesi, 58  
 Agboin, 49  
 Agoyn, 53  
 Aguegbé, 17  
 Agui, 74  
 Aguil, 74  
 Ahon, 67  
 Ahun, 67  
 Aja, 47  
 Ajumkobi, 47  
 Akan, 47, 49  
 Akbo, 17  
 Ake, 41  
 Akéde, 74  
 Akogha, 14  
 Akokogbo, 25  
 Ako-ogea, 36  
 Akor, 26  
 Akosica, 11  
 Akossica, 11  
 Akoto, 76  
 Akoura, 14  
 Akpa etuidiwi, 43  
 Akpakpa, 41  
 Akpaku, 25  
 Akpanya, 41  
 Akpapia, 14  
 Akpe, 17  
 Akpwania, 41, 42  
 Akun, 69  
 Akutobasa, 60  
 Akwantanuro, 29  
 Albizzia, 84  
 Albizzia sp., 52  
 Aligna, 38  
 Almond, 53  
 Alone, 29  
 Alstonia, 83  
 — *congensis*, 66  
 — *scholaris*, 66  
 Alui, 74  
 Alukon-raba, 23  
 Ameliki, 58  
 Amelliky, 58  
 Amoreira, 74  
 Amuan, 21  
 Anamammilla, 28, 29  
 Anyan, 47  
 Apa, 38  
 — oro, 38  
 Apapa, 78  
 Apobo, 29  
 Apocynaceæ, 66  
 Apopo, 28, 29  
 Appaka, 38

- Appapayayi, 26  
 Appapayi, 26  
 Apuro, 64  
 Aquabo, 23  
 Araba, 17  
 Arache, 43  
 Arachi, 38, 43  
 Arere, 19  
 Arhoné, 44  
 Aronhe, 44  
 Asama, 70  
 Asamogo, 26  
 Asoma, 70  
 Assomah, 70  
 Assosica, 11  
 Atala, 21  
 Atchipon, 64  
 Atiema, 44  
 Attalla, 21  
 Auchi, 32  
 Auwolo, 35  
 Awama, 70  
 Awessu, 58  
 Awesu, 58  
 Awigbo, 14  
 Awolo, 35  
 Awun, 67  
 Ayibukpo, 38  
 Ayin-bukbo, 38  
 Azobe, 14  
  
 Baa, 38  
 Badi, 58  
 Baffili, 26  
 Bahia, 64  
 Bakana, 74  
 Bakunin, 67  
 Balsam, 35, 36  
 Bambarra, 14  
 Bamba-kofi, 38  
 Bang, 14, 74  
 Bangi, 44  
 Bangossi, 14  
 Bantang foro, 67  
*Baphia nitida*, 31, 32, 34  
 Bara, 62  
 Barwood, 31, 32  
 Baumwollbaum, 17  
 Baya, 58, 64  
 Beket, 74  
 Bélarbinekélé, 11  
 Belengbé, 14  
 Bendiguri, 38  
  
 Bendwi, 32  
 Benten, 17  
 Benterier, 17  
 Bessi, 35  
 Bilenga, 38  
 Bilinga, 38, 58  
 —, Yoruba, 38  
 Bilingbe, 14  
 Bintafora, 17  
**Bixaceæ**, 11  
 Blackheart, 14, 15  
 Bodo, 64  
 Bofeko, 70  
 Boi-feko, 70  
 Bois de Bahia, 64  
 — — fer, 14  
 Boko, 14  
 Bokome, 53  
 Bokuk, 67  
 Bokuka, 67  
 Bokuka-ba-mhale, 67  
 Bolondo, 49  
**Bombaceæ**, 17  
*Bombax guineense*, 17  
 — *pentandrum*, 17  
 Bongossi, 14  
 Bonzo, 74  
 Boo, 36  
 Bosambai, 69  
 Bosambe, 69  
 Bosambi, 69  
 Bourane, 44  
*Brachystegia*, 70, 86, Pl. III  
 — *spicæformis*, 41  
 Bu, 36  
 Bubalinabo, 36  
 Bundwi, 32  
 Burukossa, 64  
  
**Cæaslpineæ**, 35, 37, 41, 43, 46,  
 49  
 Camba Camba, 74  
 Camwood, 31  
 —, South Nigerian, 31  
 Casca-bark-tree, 44  
 Casca-pano, 41  
*Casearia sp.*, 56, 84, Pl. III  
 Cedar, 25  
 — Mahogany, 25  
*Ceiba casearia*, 17  
 — *pentandra*, 17  
 Chen, 49  
 Chenga, 41

- Chlorophora*, 85, Pl. III  
 — *excelsa*, 73  
 Cokewood, 74  
**Combretaceæ**, 53  
 Contah, 38  
 Corkwood, 74  
 Cotonnier, faux, 17  
 Cotton-tree, Silk, 17  
 Cotton-tree, white, 17  
 Counter-wood, 38  
*Cyanothyrsus*, 35  
*Cylicodiscus*, 84, 86, Pl. II  
 — *gabunense*, 47, 49  
  
 Daberna, 49  
 Dahomah, 49  
 Dahuma, 49  
*Daniella Olivierii*, 35, 41  
 — *thurifera*, 35  
*Daniellia thurifera*, 35  
*Dasylepis*, 11  
 Denya, 47, 49  
 Dervo, 14  
 Digiten, 26  
 Diki, 26  
**Dipterocarpaceæ**, 14  
 Dirinshi, 26  
 — Diki, 26  
 Djombe, 53  
 Doy, 58  
 Dragounier, 17  
 Dsati, 35  
 Dubu, 67  
 Dunchi, 35  
 Dundaka, 58  
 Dundake, 58  
  
 Eba, 14, 67  
 Ebba, 14  
 Ebar, 64  
 Ebbome, 49  
 Eben, 58, 60  
 Ebengiku, 60  
 Ebo, 56  
 Ebu, 67  
 Eckou, 67  
 Edat, 21  
 Edde, 11  
 Eddé, 11  
 Edoum, 74  
 Edum, 47  
 Edundu, 49  
 Efryio, 74  
  
 Egbesaye, 58  
 Egbesi, 58  
 Eggun, 17  
 Egna, 17  
 Egoyu lukan, 55  
 — nebbi, 55  
 — nikwi, 55  
 — nufwa, 53  
 Ehan, 70  
 Ehé, 49  
 Ehimí, 49  
 Eisenholz, 14  
 Ekhimí, 49  
 Ekkimi, 49  
 Eki, 14  
 Ekki, 14, 15, 70  
 Eku, 14, 41, 70  
 Ekuri, 67  
 Ekusawa, 58  
 Ela, 14  
*Elæis*, 19  
 Eleba, 14  
 Elégué-mouani, 44  
 Elélom, 64  
 Elelommzame, 64  
 Ellondo, 44  
 Ellong, 44  
 Elélou, 64  
 Elm, 74  
 —, rock, 74  
 Eloun, 44  
 Elui, 74  
 Emang, 74  
 Emanga, 17  
 Emien, 67  
 Emil, 55  
 Emmiri, 53, 55  
 Eng, E. Indian, 21  
 Engessan, 70  
 Engessang, 70  
 Endwi, 14  
 Enonee, 28, 29  
 Ensale, 49  
*Entandrophragma* *sp.*, 29  
 Entwi, 14  
 Enwan, 14  
 Enyena, 17  
 Enyenga, 17  
 Enyina, 17  
 Enyo, 17  
 Epepe, 55  
 Erhoné, 44  
 Erimado, 70

Erimmado, 70  
*Eriodendron*, 21, 71, 83  
 — *anfractuosum*, 17  
 — *guineense*, 17  
 — *orientale*, 17  
 Erüi, 44  
 Erui, 44  
 Erum obo, 44  
 Erun, 44  
 Erundu, 49  
*Erythrophleum*, 86, 87, Pl. III  
 — *gabunense*, 47  
 — *guineense*, 43, 46  
 Esango, 70  
 Eso, 14  
 Esoré, 14  
 Esoua, 21  
 Essoubo, 58  
 Etare, 41  
 Etiap, 67  
**Euphorbiaceæ**, 69, 70, 72  
 Ewon, 49  
*Excoecaria*, 72, 87  
 Eyo, 44

Fasa-daga, 38  
 Fig, 58  
 —, African, 58  
 —, country, 58  
*Fillea suaveloens*, 43  
*Flacourtiaceæ*, 56  
 Fofu, 64  
 Fram, 53  
 Fromager, 17  
 Funfun, 70

Gadeau, 26  
 Gara, 14  
*Garcinia*, 12, 85, Pl. II  
 — *nigricans*, 14  
 Gbassei, 35  
 Gbolei, 70  
 Gbon, 49  
 Gli, 44  
 Gofa, 64  
 Golli, 58  
 Gongona, 38  
 Gouda, 44  
 Greenheart, 47, 49  
 —, African, 47, 49  
*Guarea*, 24, 28, 87, Pl. II  
 — *Thompsonii*, 24  
 Guenlé, 74

Guié, 44  
**Guttiferae**, 12  
 Hadenya rafi, 62  
 Haipi, 70  
 Hapi, 70  
 Haya, 44  
 Hendui, 14, 15  
*Hexalobus crispiflorus*, 78  
 Hobo, 70  
 Hofa, 19  
 Hoho, 70  
 Honguié, 67  
 Hula, 32  
**Humiriaceæ**, 21

Ibo, 44  
 Idigbo, 55  
 Idu, 67  
 Ifainaki, 23  
 Igo, 32  
 Iji, 47  
 Ikkimi, 49  
 Ikpani, 38  
 Ikpanya, 41  
 Ikwahobo, 29  
 Ille, 41  
 — pagini, 41  
*Intsia africana*, 37  
 Inyi, 44  
 Ipahan, 14  
 Ipahau, 14  
 Ipawhaw, 14  
 Iroko, 74  
 Ironpost, 14  
 —, red, 14  
 Ironwood, 14  
**Irvingiaceæ**, 23  
 Isa, 53  
 Isain, 70  
 Ishan, 14  
 Issanguila, 70  
 Issieh, 53  
 Iteruku, 49  
 Iya, 35, 36  
 — Odan, 36

Jadali, 58  
 Jondo, 49  
 Kadanyar kurumi, 62  
 — rafi, 62  
 Kadaura, 35, 36

- Kako, 14  
 Kakoo, 14, 15  
 Kaku, 14  
 Kambala, 74  
 Kanja, 67  
 Kao, 38  
 Kapok, 17  
 Kapokier, 17  
 Karon-maje, 36  
 Kasa, 44  
 Katank, 14  
 Katlahi, 36  
 Kauwi, 67  
 Kauwo, 38  
 Kawo, 38  
 Kbandé, 44  
 Kebarra, 38  
 Kedjedjelo, 60  
 Kekeu, 44  
 Kekrefunde, 14  
 Kenjang, 35  
*Khaya*, 86, 87  
 — *grandis*, 26, Pl. IV  
 — *grandifolia*, 26  
 — *grandifoliola*, 26  
 — *senegalensis*, 26  
 Kina du Rio-nunez, 58  
 Kishia, 58  
 Kisia, 58  
 K'kuperb, 49  
*Klainedoxa*, 86  
 — *gabonensis*, 23  
 Kobodigansu, 64  
 Kojagei, 53  
 Kokank, 14  
 Kokué, 67  
 Konta, 38  
 Kotublasu, 14  
 Kotublassu, 14  
 Kpakpa, 38  
 Kpendi-deli, 38  
 Kpessei, 35  
 Kroma, 23  
 Krubua, 26  
 Kuge, 67  
 Kuperf, 49  
 Kura, 44  
 Kuru, 14  
 Kusia, 58  
 Kusiaba, 58  
 Kussiabah, 58  
 Kwantanuro, 29  
 Kwatenura, 29  
 Kwatinru, 29  
 Kwatinura, 29  
 Laintlain, 14  
**Leguminosæ**, 31, 35, 37, 41, 43,  
 46, 49, 52  
 Leroi, 67  
 Lerué, 67  
 Lignum Djimo, 58  
 Limba, 53  
 Lipiti, 35  
 Lo, 44  
 Logo asagu, 74  
*Lophira*, 70, 84, Pl. II  
*Lophira alata*, 14  
 — *procera*, 14  
 Lorué, 67  
*Lovoa*, 85, 87, Pl. IV  
 — *Klaineana*, 28  
 Lucula, 32  
 Macarara, 41  
 Mafuma, 17  
 Mafumeira, 17  
 Mage, 35  
 Mahogany, 21, 25, 26, 28, 29, 38, 47  
 —, African, 26, 28, 29, 38  
 —, big-leaved, 26  
 —, Benin, 26  
 —, close-grained, 25  
 —, Rhodesian, 38  
 —, scented, 25  
 Mahogany-bean, 38  
 Mahonhe, 62  
 Maji, 36  
*Mamboga stipulosa*, 64  
 Mana, 14  
 Manar-manar, 14  
 Mandji, 38  
 Mangi, 74  
 Maple, African, 19  
 —, bush, 19  
 Mapondo, 41  
 Marotta, 41  
 Masche, 35  
 Mbang, 74  
 Mbeli, 49  
 Mbeli-deli, 47, 49  
 Mbeliguli, 49  
 Mboi, 64  
 M'bundu, 74  
 M'Chenga, 41  
 M'Cheng'a, 41

- Mecombo, 41  
 Meenzerrah, 14  
 Meesoofee, 17  
 Meli, 44  
**Meliaceæ**, 26, 28  
 Méné, 14  
 Meneh, 14  
 Meni-oil-tree, 14  
 Meno, 14  
 Millai, 14  
 Milley, 14  
**Mimosæ**, 52  
*Mimusops*, 58  
*Mitragyne*, 58, 84  
 — *macrophylla*, 64  
 M'kung, 17  
 M'nenga, 41  
 Mokongo, 74  
 Momangi, 74  
 Monong, 17  
*Moraceæ*, 73  
 Moreira, 74  
*Morinda citrifolia*, 32  
 Mosouhouga, 21  
 Mougongome, 70  
 Mpangu, 41  
 Mpwere, 49  
 Mshlume, 62  
 M'tamba, 41  
 M'toto, 14  
 Muambacamba, 74  
 Muangue, 32  
 Mubiri, 32  
 Mucamba-camba, 74  
 Muenge, 32  
 Mufuma, 17  
 Mufumeira, 17  
 Mugonha, 62  
 Muhambo, 62  
 Mukonja, 53  
 —, weiss, 53  
 Muneunza, 49  
 Mungo, 64  
 Mungualle, 70  
 Mupanda, 41  
 Mupondo, 41  
 Muti, 74  
 Muvule, 74  
 Muzungo, 49  
 M'vuku maza, 64  
 Mwabwi, 44  
 Mwavi-bark, 44  
 Mwenya, 62  
 Nainvi, 49  
 Namijinkadai, 14  
 Namijin-kade, 14  
 Nbob, 70  
 Nchioumbou, 49  
 Nchoumbou, 49  
 Ndat, 21  
 Ndonga, 14  
 Nguéhié, 17  
 Nguié, 44  
 N'Gula, 32, 33  
 Niam, 14  
 Niam-fat-tree, 14  
 Niamidua, 67  
 Nijinkade, 14  
 Nikiba, 62  
 Nimeribaka, 67  
 Njangsang, 70  
 N'kassa, 44  
 Nkohen, 32  
 N'Kokongo, 38  
 Nkom, 53  
 N'Kondjo, 23  
 Nokue, 14  
 Nonble, 58  
 Npanda, 41  
 N'san, 74  
 Nsa-sana, 70  
 N'tong, 74  
 Ntowo, 64  
 Nungka, 14  
 Nya-me dua, 67  
 Nyimo, 60  
 Oaha, 53  
 Oak, African, 14, 38, 74  
 — —, red, 14  
 —, bush, 74  
 —, scrubby, 14  
 Obang, 74  
 Oba's-tree, 74  
 Obeche, 19  
 Obechi, 19  
 Obiache, 58, 60  
 Obo, 44  
 Obobonikwi, 25  
 Obobonufwa, 25  
 Obon, 26  
 Oca, 17  
**Ochnaceæ**, 14  
 Ochwan, 41  
 Ochwen, 42, 70  
 Odahuma, 49

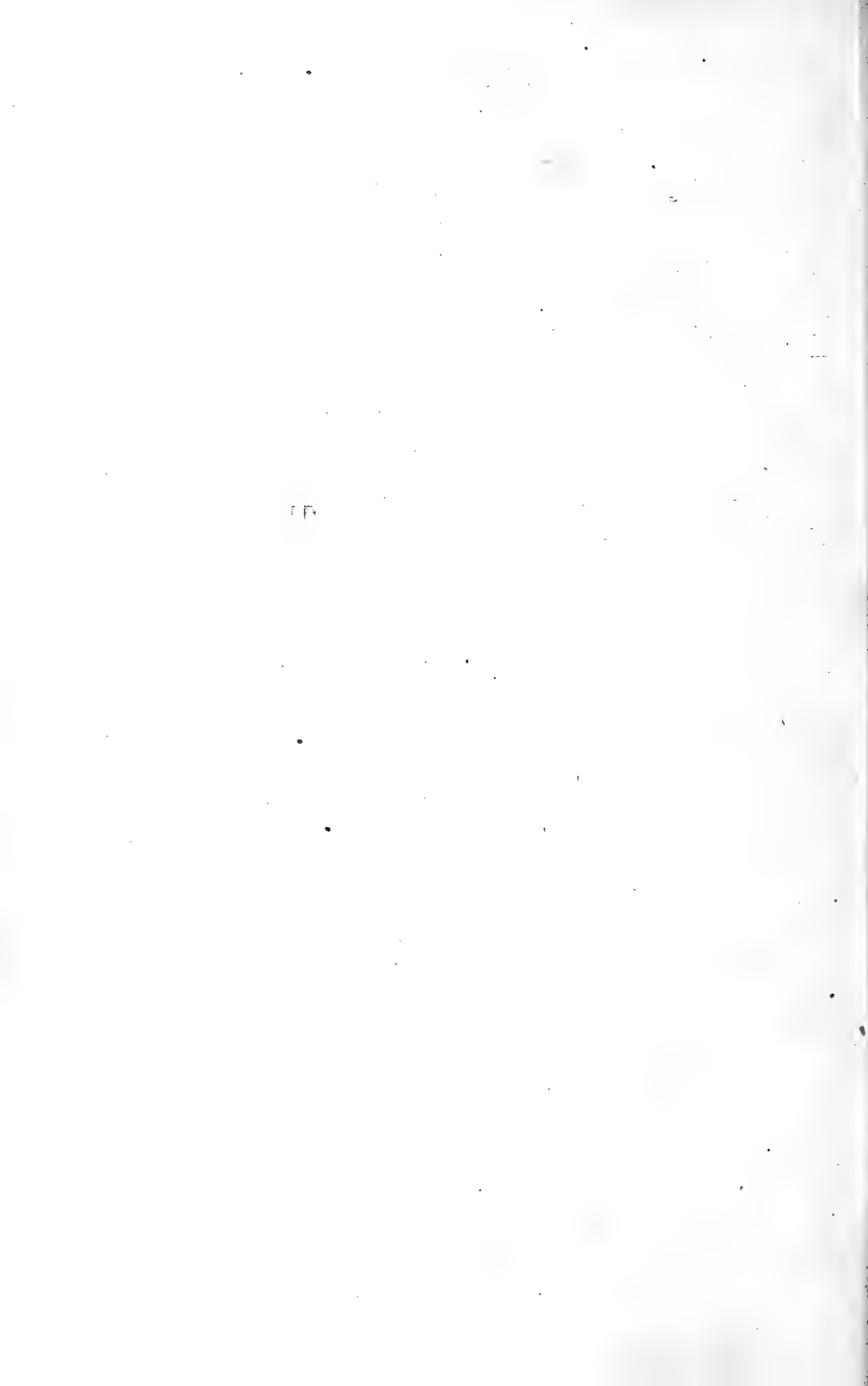
Odala, 26  
 Odenya, 47, 49  
 Odji, 74  
 Odogbo, 25  
 Odom, 74  
 Odoum, 17, 74  
 Odudu, 23  
 Odum, 17, 74  
 Ofemm, 67  
 Offram, 53  
 Ofrafraha, 49  
 Ofryio, 74  
 Ofwho, 17  
 Oganedjo, 64  
 Oganwo, 26  
 Ogeagum, 36  
 Ogea-gum, 36  
 Oginyi, 44  
 Ogouwa, 64  
 Ogudugbu, 67  
 Oguk, 67  
 Ogwango, 26  
 Ogwangu, 26  
 Oigo, 32  
 Okan, 47, 49  
 Okan, the smaller, 50  
 Okha, 17  
 Okikopon, 14  
 Okilolo, 11  
 Okoka, 14  
 Okot, 14  
 Okro Koods, 70  
 Okunmankra, 26  
 Okusia, 58  
 Okut, 14  
 Okwein, 41  
 Okwen, 41, 70  
 Okwenseva, 70  
 Olokemeji, 53  
 Oloko, 74  
 Olokokima, 38  
 Olosan, 47  
 Omuvumvu, 44  
 Ongina, 17  
 Onhon, 58  
 Onyina, 17  
 Opapao, 38  
 Opepe, 55, 58, 60  
 —, false, 64  
 —, Swamp, 64  
 Opepea, 38  
 Ordeal-bark, 44  
 Oregbe Erin, 79, 87

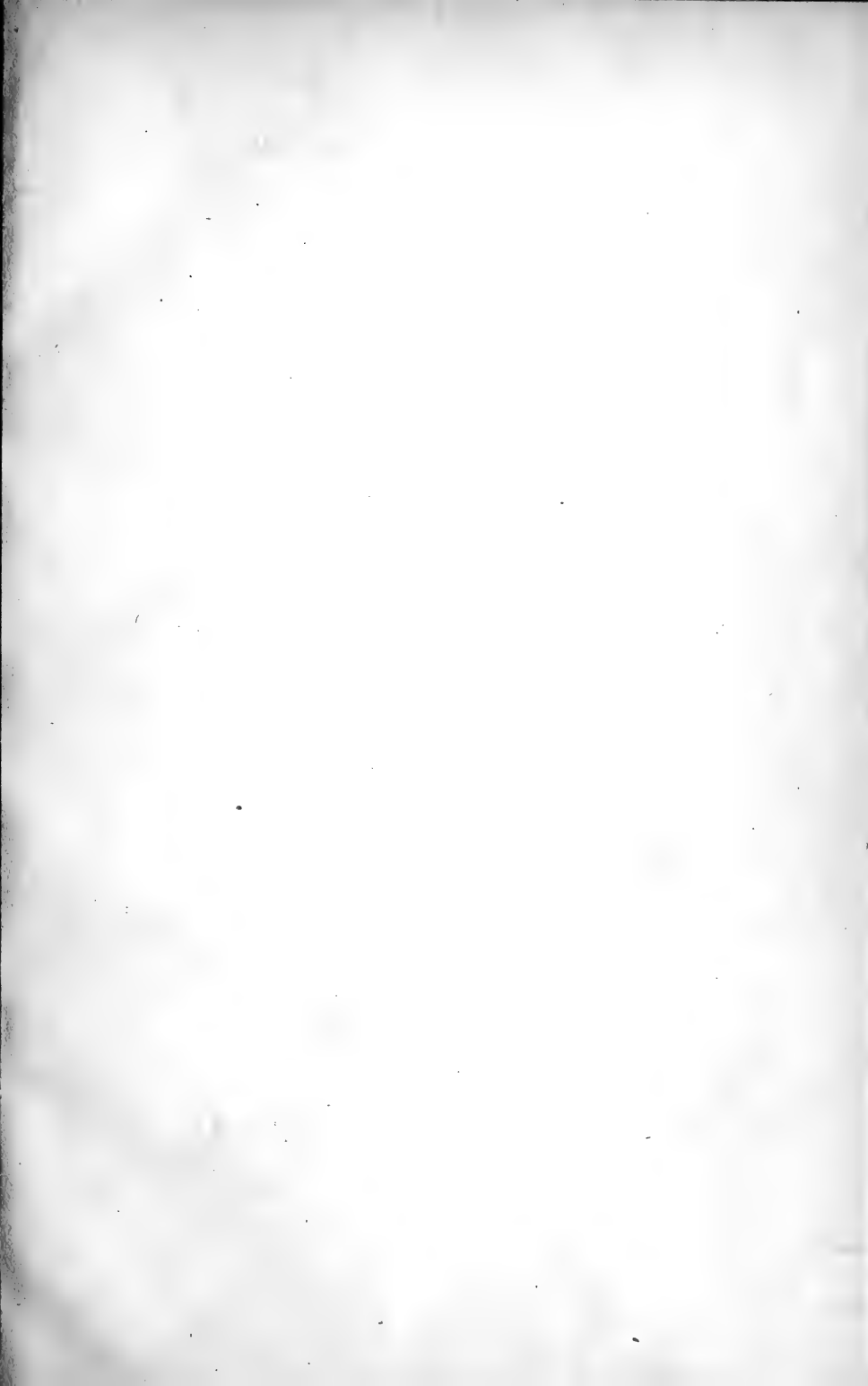
Oroko, 74  
 Orokpo, 35  
 Orupa, 72  
 Osaba, 35  
 Osho, 47  
 Osia, 35  
 Osikiba, 62, 64  
 Ossoupou, 64  
 Osun, 32  
 Otugba, 14  
 Oue-oue, 14  
 Ouia, 17  
 Owama, 70  
 Owawa, 19  
 Owa-wa, 19  
 Owawe, 19  
 Owema, 70  
 Owessu, 58  
 Owewe, 52  
 Owussu, 58  
 Oyiz, 35  
 Ozaneguila, 70  
 Ozia, 35  
 Ozouga, 21  
 Ozougo, 21  
  
 Padauk, African, 32  
 Panda, 41  
 Pan de frute, 58  
 Pao d'oleo, 62  
 Pao ferro, 41  
 — musence, 49  
 Papapa, 81, 84, 86  
 Papao, 38  
 Papaobaum, 38  
 Papau, 38  
**Papilionaceæ**, 31  
 Papow, 38  
*Paradaniellia*, 85, Pl. II  
 — *Olivierii*, 35  
 — *thurifera*, 35  
 Parapara, 14  
*Parinarium*, 53  
 Patabua, 19  
 Pattern-wood, 67  
 Pau d'oleo, 62  
 Peach, 58  
 —, African, 58  
 —, negro, 58  
 —, Sierra Leone, 58  
 Peach-root, 58  
 Pebedum, 28, 29  
 Penkwa, 29

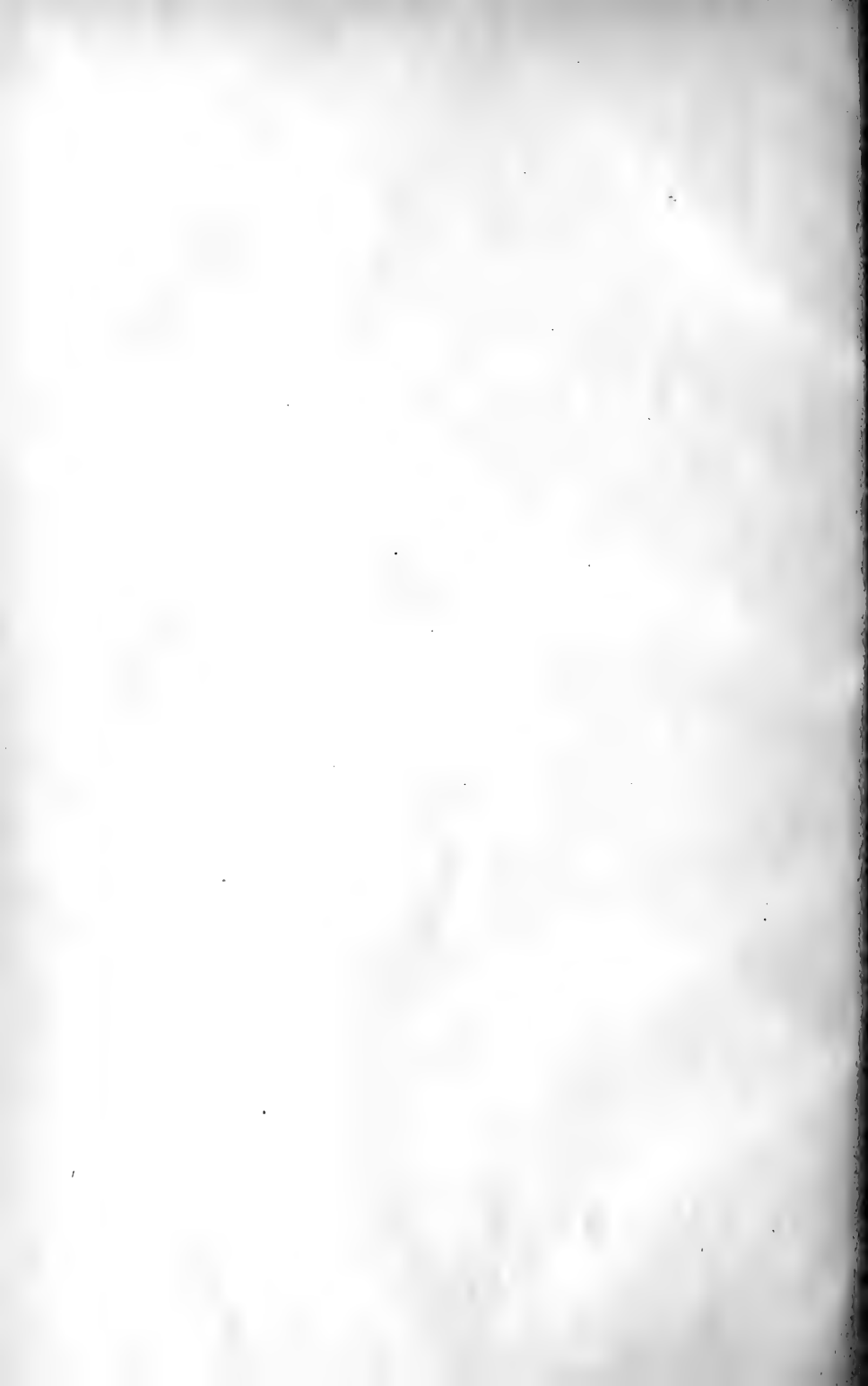


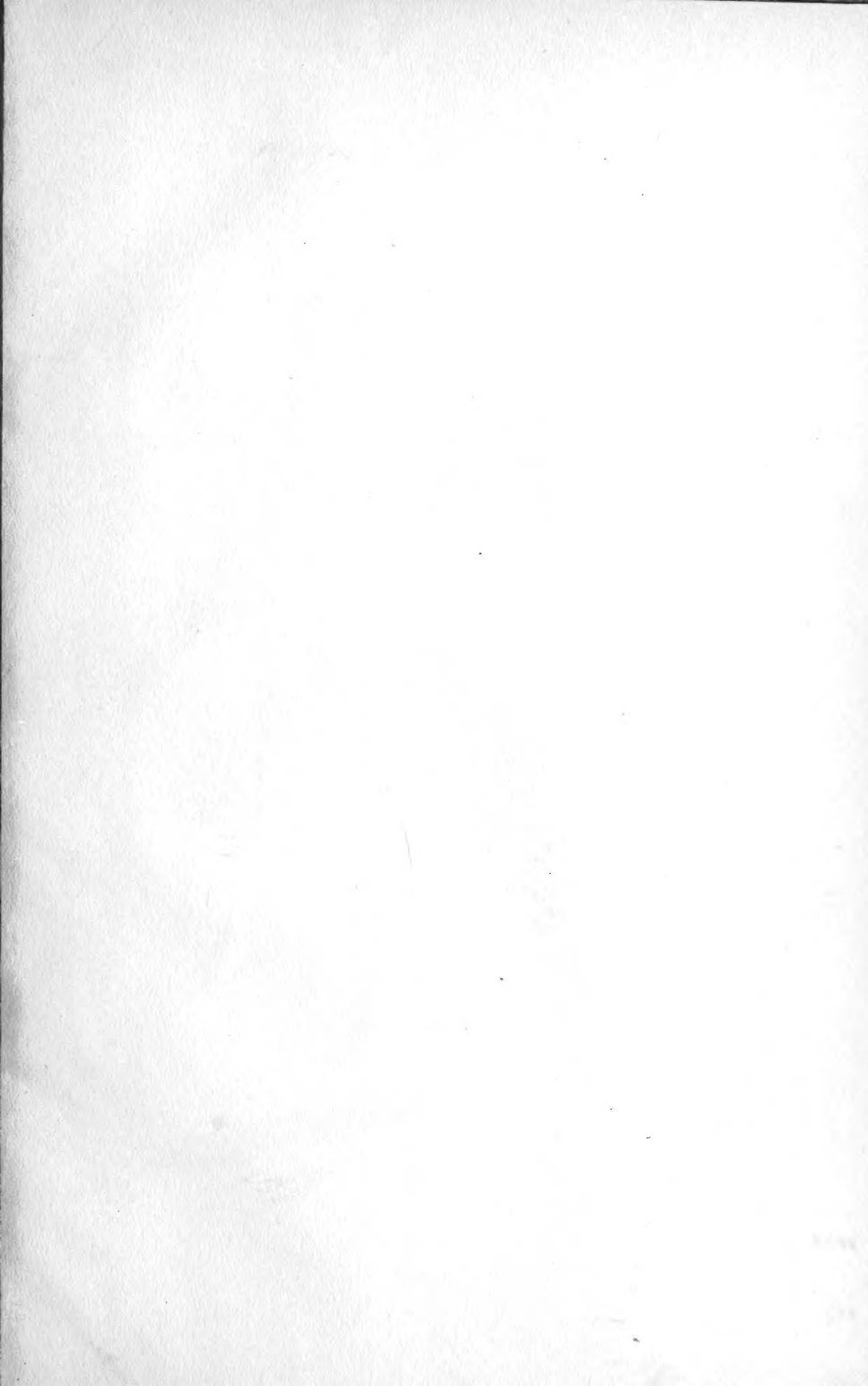
- Pentaclethra macrophylla*, 78  
 Pepedum, 29  
*Piptadenia*, 47, 86, Pl. III  
   — *africana*, 49  
 Poison d'épreuve, 44  
 Ponhon, 14  
 Poposi, 70  
 Potrodon, 44  
 Protodon, 44  
*Pseudo-Cedrela sp.*, 28  
*Pterocarpus*, 58, 86, 87, Pl. II  
   — *Cabrae*, 32  
   — *esculentus*, 32  
   — *Osun*, 32  
   — *Soyauxii*, 32  
   — *tinctorius*, 31  
 Pullum, 17  
 Puttuputtu, 70  
*Pycnanthus*, 69  
  
 Quinine, African, 58  
 Quinquina africain, 58  
  
 Red-water-tree, 44  
 Redwood, 32, 49  
*Ricinodendron*, 18, 41, 70, 83  
   — *africanus*, 18, 70  
   — *Heudelottii*, 70  
   — *Rautenii*, 70  
 Rimi, 17  
 Ringa, 14  
 Rini, 17  
 Rokko, 74  
 Roko, 74  
**Rubiaceæ**, 57, 60, 62, 64  
  
 Sa, 35  
*Saccoglottis*, 87  
   — *gabunensis*, 21  
 Sainja, 35  
 Sama, 19  
 Samba, 19  
 Sanga, 14, 49  
   — Sanga, 70  
 Sankamba, 19  
 Santang, 36  
*Sarcocephalus*, 38, 55, 62, 64, 72,  
   86, Pl. IV  
   — *esculentus*, 57, 60  
   — *sambucinus*, 57, 60  
 Sarutu, 62  
 Sassa, 44  
 Sass-wood, 44  
  
 Sassy-bark, 44  
 Satinwood, 19  
*Saxoglottis gabunensis*, 21  
*Scottellia*, 84, Pl. IV  
   — *kamerunensis*, 11  
 Sefono, 64  
 Semee, 74  
 Sendar, 25  
 Shakka, 17  
 Shingle-wood, 53  
 Sibo, 58  
 Sida, 25  
 Sidu, 25  
 Sifu Sifu, 38  
 Silk-cotton-tree, 17  
**Simarubaceæ**, 23  
 Sime, 74  
 Simoma, 17  
 Sindra, 67  
 Sindru, 67  
 Sindura, 67  
 Singa, 49  
 Sofo, 64  
 Somba-umba, 17  
 Sosau, 70  
 Soufo, 64  
 Ssare, 74  
 Sserre, 74  
*Sterculia sp.*, 74  
 Stool-wood, 67  
 Suma-uma, 17  
 Swamp Opepe, 58, 60, 62, 86  
  
 Tabu, 60  
 Tacula, 32  
 Tafasiya, 58  
 Tala, 21  
 Tali, 44  
 Talli, 44  
 Teak, African, 58, 74  
 Tele, 44  
 Télé, 44  
 Téli, 44  
 Tema, 74  
*Terminalia*, 53, 55, 58, 84, 85, 86,  
   87, Pl. IV  
   — *altissima*, 53  
   —, Blackbark, 55  
   — *scutifera*, 53  
   — *sp.*, 84, 85, 86  
   — *superba*, 55, 84, 86, 87, Pl. IV  
   — *velutina*, 53  
   —, yellow, 55

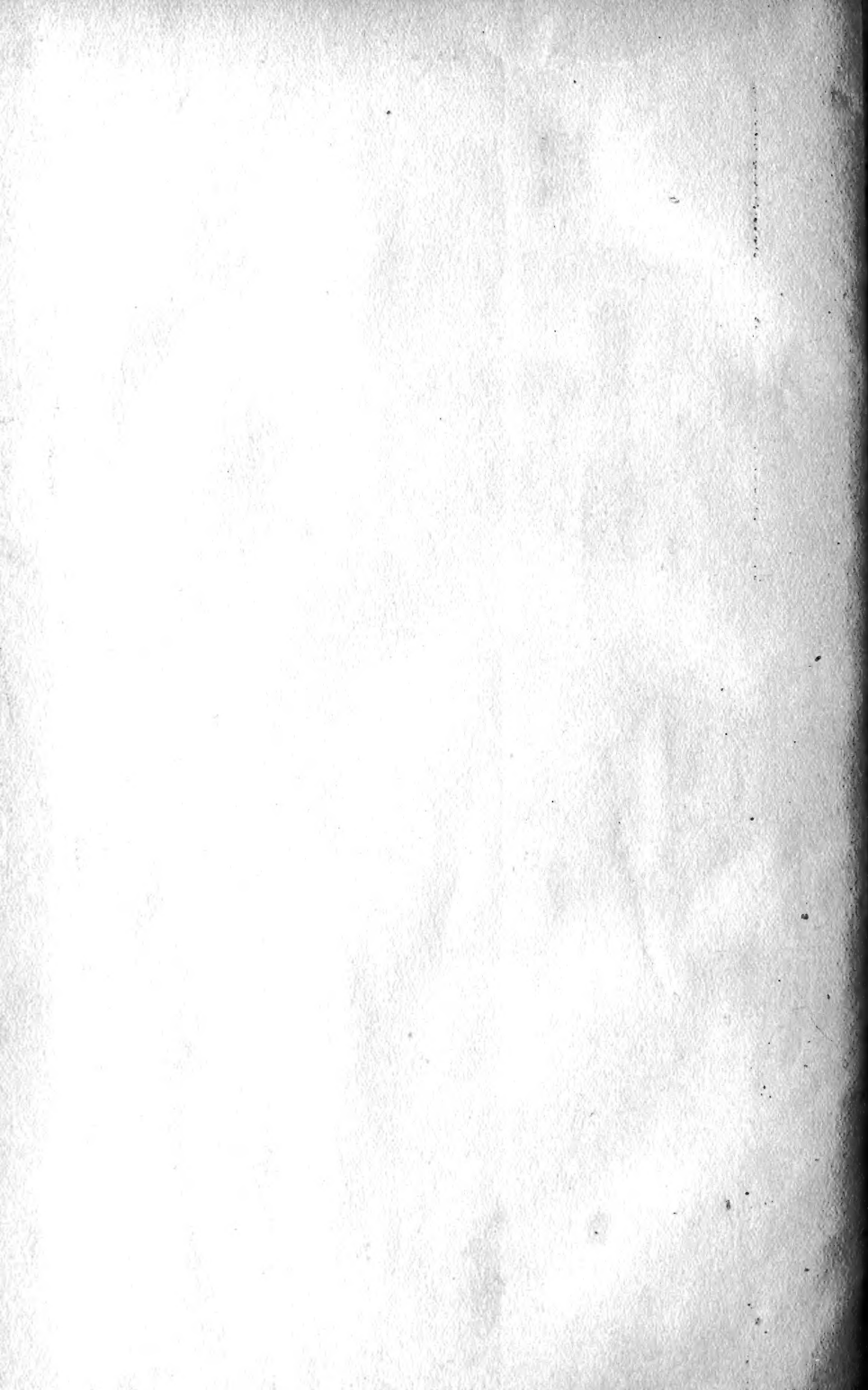
- Tétére, 58
- Thievi, 36
- Tia, 44
- Tilleul d'Afrique, 64
- Togba, 64
- Tondo, 41
- Tonko, 17
- Triplochiton*, 19, 83
- Triplochitonaceæ**, 19
- Triplochiton Johnsonii*, 19
- *nigericum*, 19
- *scleroxylon*, 19
- Troum, 49
- Tsa, 44
- Tsain, 70
- Tschato, 35
- Tzontzo, 41
  
- Uapaca*, 87
- *Staudtii*, 69
- Ubellu, 29
- Ubuen, 64
- Ugbodokossa, 64
- Ughberi, 14
- Ugu, 21
- Uhie, 32
- Uhu, 67
- Ukhu, 67
- Ukloba, 74
- Ukpa, 32, 34
- Ukpu, 67
- Ukun, 17
- Ukung, 41
- Uloko, 74
- Uloko-nusingbon, 74
- Ulokoodigpe, 74
- Ume, 32
- Umowanek, 14
- Umpanda, 41
- Umpenek, 14
  
- Ungu, 41
- Ungwe, 17
- Upenikwa, 15
- Upono, 26
  
- Vai, 74
- Viku, 58
  
- Walnut, African, 28, 29
- Wansanwah, 26
- Wawa, 19
- Wa-wa, 19
- Wawwaw, 19
- Weather-board-wood, 58
- Welu, 38
- Whitewood, 67
- Woacroolie, 58
- Wokuka, 67
- Wongasanga, 70
- Wonjangasanga, 70
- Wood-oil-nut-tree, 70
- Wood-oil-tree, 36
- Wowata, 14, 15
- Wuacruli, 58
- Wunga, 49
  
- Yagale, 14
- Yaryah, 64
- Yaya, 64
- Ya-ya, 64
- Yahyah, 64
- Yellow-fever-root, 58
- Yellow-wood, 60
- Yowi, 64
- Yuku, 64
  
- Zawa, 14
- Zembi, 23
- Zimingela, 53











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